NATIVE WEST INDIAN PLANT USE

By

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This is an archaeological study of the plant component of diet and human adaptation in the Caribbean islands. Archaeobotanical data from Caribbean sites, which form the basis of this research, have been largely unstudied to date. Nevertheless, plants play a central role in models that attempt to explain how Ceramic Age migrants from South America adapted to the insular environment.

Nineteen sites were tested archaeologically to provide the first comprehensive view of plant use in the region. The collective archaeobotanical data from Archaic and Ceramic Age occupations form profiles of plant use that correspond with early, later, and the final stages of migration, settlement, and social organization in particular island groups. The results indicate that plant resources were an integral part of prehistoric West Indian economies,

and that gardening may have been initiated in the Caribbean Archaic Age. Native plant food resources were used in combination with important homegarden trees that originate in mainland areas. Several of these species appear to have been transported to the islands by Archaic Age people, and the evidence for plant introductions from the Central American/Yucatan region is just as compelling as from South America.

Root-crop horticulture may have been introduced in conjunction with the Saladoid settlement of the Lesser Antilles, even though evidence of domesticated plants is without substantiation by plant remains until relatively late in the sequence of human occupation. The presence of prehistoric maize is confirmed only at En Bas Saline, Haiti, in deposits dating between approximately A.D. 1250 and 1500. Maize cultivation in the West Indies may have been overshadowed by the primary system of root-crop horticulture. The plant remains themselves, combined with the presence of plant-processing artifacts and ethnohistorical observations, are beginning to suggest a uniquely West Indian pattern of plant use.

CHAPTER 1

INTRODUCTION

American Indian groups inhabited the Caribbean Islands for several thousand years prior to the fateful entry of Europeans into the region, and during all that time, plant foods and products were essential to their survival and successful adaptation. Plants provided food and medicine, and fuelwood was essential for cooking and heating. The local vegetation was also the source of raw materials for building construction, transportation, weapons, tools, fiber industries, and products such as gums, resins, tannins, paints, and fish poisons.

Few primary data bases exist, however, with which to profile the plant component of prehistoric economies in the Caribbean. The paucity of data is largely a reflection of the fact that only recently has systematic archaeobotanical research been undertaken in the region. Nonetheless, plants play a central role in models that attempt to explain Caribbean Indian life, and, in particular, how Ceramic Age migrants from northern South America adapted to the drastically different environment of the West Indies.

Early cultures in the Caribbean are typically portrayed as practicing generalist, foraging economies (Armstrong 1980; Davis 1988; Rouse 1992:58; Veloz Maggiolo 1976:257-

258). The transition to gardening and the manipulation of local floras, either intentionally or otherwise, have essentially gone without consideration. Gardening and other more deliberate means to procure plant food items are generally thought to be phenomena that coincide with the migration of Amazonian root-crop horticulturists into the Lesser Antilles. The later emergence of complex, socially stratified societies in the Caribbean appears to be linked to the development of subsistence economies based on more intensive forms of plant production, including agriculture (Rouse 1992; Wilson 1990). However, the development of these systems is at best poorly understood.

Changes in subsistence and general economic patterns have long been a preoccupation of Caribbeanist archaeologists. Apparent shifts in emphasis on different food items or categories of foods appear to occur in the archaeological record, based primarily on the presence of zooarchaeological remains and on changes in settlement pattern (cf. Seigel 1990). For example, the "crab-shell" dichotomy (Jones 1985; Keegan 1989) is broadly defined to theoretically indicate a dietary shift on some islands from a diet based on land crabs and terrestrial fauna to one emphasizing marine foods, including shellfish. Changes in plant food production are generally believed to have coincided with the shifts in protein capture and settlement patterns; nevertheless, any shift in the use of plant foods is without direct documentation (i.e., by the identification

of archaeobotanical remains). Despite the widely held belief that change occurred in the subsistence realm and that developing economic patterns represent a growing familiarity and adaptedness to the island environment, our understanding of the types of plant foods and the nature of their use is rudimentary.

This research is designed to help remedy this situation and address some of the deficiencies in interpreting Caribbean Indian economies by investigating the types and intensity of plant use in the region. This study incorporates and synthesizes paleoethnobotanical data excavated from 23 archaeological sites that effectively span the full temporal and geographic range of human activity in the region, excluding only the earliest, Lithic Age (Rouse 1989; 1992) occupations. Changes that occur between the earliest Archaic Age and later-aged Taino occupations are examined to address the issue of adaptation to the insular environment and the ease with which colonists might have adjusted to the insular setting. The plant data track the development of a uniquely Caribbean Indian pattern of plant use. Archaeological, archaeobotanical, artifactual, and ecological data are used to address questions about the first appearance of gardening and arboriculture in the region, when dependence on cultivated plants seems to have intensified, and identify source areas for important cultigens and fruit trees.

The sites producing archaeobotanical data have components variously attributable to Archaic and the later Ceramic Age occupations of the Caribbean islands, except that the Lucayan Taino of the Bahamas Island group are not included. The data are necessarily weighted toward the Ceramic Age sites, which tend to have undergone more extensive testing and more often have had paleoethnobotany integrated into the overall plan of research for the site. Moreover, the number of samples and the amount of data collected necessarily varies from one site to the next, and data from the Lesser Antilles sites in particular are minimal. To overcome sampling discrepancies and problems inherent in comparing such vastly differing data sets, the plant remains are examined in a generalized, regional perspective, rather than by a more quantitative approach. The identifications from each archaeological site and subregion are discussed and quantified by individual site, then viewed on a presence/absence basis in regard to the particular subregion, e.g. the northern Lesser Antilles. Particular attention is paid to plants whose presence is documented across spatial and temporal boundaries. There is enough information cumulatively to begin to question the Caribbean migration models and to address assumptions about plant use and Caribbean Indian adaptation.

In combination, the plant data from the Caribbean sites clarify plant use and the dynamic relationships between Indians and their local flora. The collective

identifications form profiles of plant use that correspond with early, later, and final stages of migration, settlement and social organization in particular island groups. Thus Archaic Age sites in the Leeward island group provide glimpses of wood selection and evidence that gardening was practiced prior to the migration of Saladoid horticulturists from northern South America. Clearly, fruit-bearing trees, like native mastic-bully, were an important part of early Saladoid subsistence; plant evidence from later Saladoid and Ostionoid sites on Puerto Rico show that gardening and arboriculture became increasingly more important. Finally, Classic Taino sites on Hispaniola provide the first evidence verifying the presence of the root-crop and maize production system described in the historic accounts.

Because this is one of the first archaeological attempts to detail the nature of plant use by Caribbean Indians, the questions asked are broad and relate to fundamental issues of adaptation and subsistence change. The immediate objective is to contribute to an understanding of plant use in the Caribbean by refining our information about indigenous subsistence economies. This research establishes a foundation for a better-informed understanding of the dynamic relationship between Caribbean Indians, including the Taino who represent the final stages of the migration events, and the island environments they inhabited. The resulting model of plant use provides finer resolution with which to examine the colonization effort in

particular, and human adaptation to insular environments in general. In addition to clarifying the role of plant resources to Caribbean Indian existence, broader applications of this study are to island biogeographic theory and the theoretical understanding of the development of complex chiefdoms.

The format of this study is as follows. In Chapter 2 background information critical to an understanding of the general context of this research is presented. First, the sequence and nature of human occupations in the Caribbean region are summarized. Next, briefly outlined are several current models of adaptation and subsistence change, including a discussion of the basis for propositions about the types of and changes in the plants used by various Caribbean peoples. Then, the history of archaeobotanical research on West Indian sites is reviewed and the questions addressed by this study are formulated. In Chapter 3, the sites incorporated in this study are briefly described, with emphasis on the types of depositional contexts from which were recovered the plant remains. Following the site summaries is a brief description of the methods used to analyze and interpret the archaeobotanical data. The results of the archaeobotanical analyses are presented in chapters 4, 5, and 6. First discussed (Chapter 4) are data from the Lesser Antilles sites, beginning with sites located in the southernmost part of the region and ending with the Virgin Islands at the northern extent. By presenting the

data from south to north, they appear roughly in the correct temporal and spatial context of the human migrations. The data from five sites in Puerto Rico are analyzed in Chapter 5. Finally, in Chapter 6 is presented the analyses for two sites on Hispaniola. Chapter 7 is a summary of the results of this research, centering on three themes. One is the definition of a uniquely Caribbean pattern of plant use. Second is the advent of gardening in the region and the first appearance of domesticated forms. The last issue is the recognition of a broader pattern of plant use, one that is shared with cultures located in other American lowland tropical areas.

CHAPTER 2

BACKGROUND AND PROBLEM FORMULATION

The basic chronology of human occupation in the Caribbean Islands is summarized in this chapter, without entering into too much detail about local or subregional culture series. The general cultural-historical summary is followed by a brief discussion of the various theories and models archaeologists have developed to interpret human existence in the islands from the perspective of food production and human adaptation. Next, the foundations for ideas about important plant foods are reviewed, beginning with certain references in historic documents, then on to what has been inferred from the presence of artifacts associated with food production, osteochemical data from human skeletal material, and, finally, pollen analytical data. These sections are followed by a short summary of details from ethnohistoric documents about particularly important plants, including manioc. Information gleaned from the documents about these plants is potentially significant to the archaeobotanical data presented in later chapters. The chapter concludes with an overview of previous paleoethnobotanical research on sites in the West Indies, setting the stage for my research.

Culture History

The earliest documented human presence in the Caribbean islands dates to approximately 6000 years ago, comprising what Caribbeanist archaeologists refer to as the "Lithic Age" (Rouse 1989, 1992). The lifestyle of these early Casimiroid people, who originated in Middle America, is only vaguely understood. These early sites are identified primarily on the basis of the exclusive presence of flaked-stone tools (Rouse 1992). Later Casimiroid sites on Hispaniola, Cuba, and Puerto Rico are marked by the addition of ground-stone implements, bone and shell artifacts, and a more diverse array of animal food remains. The presence of ground-stone tools marks the beginning of what Caribbeanists refer to as the Archaic Age.

Beginning approximately 4000 years ago another preceramic group(s) of people migrated into the Caribbean islands from northern South America. These people developed the Ortoiroid series of cultures in the West Indies, which also belong to the Caribbean Archaic Age (Rouse 1992). Thus the earliest Lithic and Archaic Age cultures in the Caribbean migrated from two directions, one from the Yucatan region of Central America and moving as far east as western Puerto Rico, and the other from northern South America, expanding north through the island arc as far as the northern Lesser Antilles and eastern Puerto Rico (Rouse 1992:69). Archaic Age sites in general are marked by a greater diversity of artifact types than that which

characterizes sites attributed to the preceding Lithic Age. Flaked-stone and ground-stone implements appear in Archaic Age deposits, as well as bone and shell artifacts. A general consensus among Caribbean archaeologists holds that the human populations comprising the Caribbean Archaic Age were generalist-foragers, who subsisted on a variety of terrestrial and marine fauna, and wild plant foods (Armstrong 1980; Davis 1988; Rouse 1992:58; Veloz Maggiolo 1976:257-258). Davis (1988:181), however, insightfully commented that at least some of the historically known cultivated plants in the West Indies possibly were transported by human groups to the islands prior to the entry of the Ceramic Age horticulturists. The data that will be presented in subsequent chapters suggest that Davis was correct in his assumption.

By at least the middle of the first millennium B.C., ceramic-producing horticulturists from lowland South America started to settle in the West Indies (Haviser 1988, 1991b; Siegel 1991a). The first wave of Ceramic Age Cedrosan-Saladoid people advanced relatively rapidly through the Windward and Leeward islands, temporarily halting their migration in western Puerto Rico. Later, descendents of the original Saladoid migrants moved on to settle Hispaniola and other islands of the Greater Antilles and the Bahamas island group. During this time (after approximately A.D. 500 [Rouse 1992]), the Saladoid culture series developed into what is termed the Ostionoid series in the Leeward Islands

and Greater Antilles (except western Cuba) and the Troumassoid/Suazoid series in the Windward Islands. Each of the later series has local variants and subseries, the description of which is beyond the scope of this discussion.

It is clear from the increasing number, size, and placement of sites and by changes in the material culture, that Saladoid Indians and their descendents flourished in the insular environment, apparently successfully adapting to the unique climate and array of available resources. By the time Europeans arrived in A.D. 1492, the Taino, who represent the final stage in the continuum of migration and human adaptation in the region, were highly specialized agriculturists and fisher people with a complex and hierarchical social structure (Wilson 1990).

Models Centered on the Human Migrations and Settlement of the Caribbean Islands

The Lithic and Archaic Age people of the Caribbean have been traced to homelands in Central and South America. Beyond the efforts to define their origins, very little research has been undertaken seeking to interpret and explain the reasons behind these early migrations. In contrast, the Ceramic Age migrations have been the focus of quite a few studies, some examining the impetus for the move, others the progress and nature of the migrations through the island system.

The expansion into the Caribbean of ceramic-producing horticulturists from lowland South America began by at least 400 B.C. (Haviser 1988; Siegel 1991a, b). Archaeological

sites along the migration route have the prominent marker of Cedrosan Saladoid ceramics, the first ceramics series to appear in the West Indies (Rouse 1986; Rouse and Allaire 1978). The migrants themselves are referred to as Cedrosan Saladoid, after their distinctive ceramic tradition. Early Saladoid people are generally believed to have practiced a tropical-forest horticultural economy based on root crops and the animal protein procured from rivers and forests (Roosevelt 1980; Rouse 1986, 1989; Wilson 1990). Later Saladoid occupations placed a strong emphasis on marine resources (Haviser 1988). The timing and details of the apparent change in focus from a subsistence strategy based primarily on terrestrial foods to one emphasizing marine and terrestrial resources has been the subject of much debate by Caribbean archaeologists (see below).

A number of models have been proposed to explain the motivations for movement into the islands, and/or the nature of expansion once it began (e.g., the pace, placement of settlements, resource base). Most researchers are in agreement that human population levels neared saturation in the floodplain of the Orinoco in the first millennium B.C. This population density resulted in fierce competition for scarce resources, specifically, prime alluvium for plant cultivation coupled with access to the abundant aquatic resources of the lowland riverine environment (Roosevelt 1980; Rouse 1986). This pressure of competition hypothetically was the prime motivation behind the radiation

of Saladoid people into the West Indies (Keegan n.d.; Siegel 1991a). The pace of migration, at least to as far as Puerto Rico, midway up the island arc, is believed to have been rapid, perhaps taking place within 2-3 generations (Haviser 1988, 1991b; Keegan 1985, 1992, n.d.; Rouse 1986, 1989; Siegel 1991b). By 600 A.D. descendents of the original Saladoid populations had moved throughout Hispaniola and into Jamaica and eastern Cuba; by at least 800 A.D. the migration encompassed central Cuba and the Bahamas (Rouse 1989).

At least two scholars have attempted to go beyond the impetus for the original emigration, to try and explain the process of migration, once underway, in the insular setting. Keegan (1985, 1992) has theorized the population front as proceeding in advance of the point where population pressure would exceed the carrying capacity of individual islands. Thus, as necessary resources became less readily available, Saladoid groups would have shifted settlement to the next available large island to begin exploiting its array of resources. This is one alternative to deal with the problem of economic shortage.

Roe (1989), on the other hand, hypothesized a "push" situation that basically is an extension of the original thrust out into the archipelago--migration fueled by overpopulation and an increasingly inadequate resource base. In Roe's model each successive island was colonized as groups were forced to create new settlements to maintain

population levels under the constrictions of the insular environments and under the demands of the primary system of manioc horticulture.

Beyond the motivating dynamics for inter-island movement and the pace of migration, a number of researchers have attempted to closely examine early and later Saladoid modes of survival at the level of diet and food production using primarily settlement pattern and zooarchaeological data. Most researchers characterize food production in the early stages of settlement on individual islands as an attempt on the part of the colonizers to replicate as closely as possible their mainland existence (Davis 1988; Goodwin 1980; Jones 1985; Petersen and Watters 1991; Roe 1989; Rouse 1989). Therefore, optimal site selection is said to have focused on larger islands with microenvironments suitable for crop production. Manioc and probably other root crops, plus all the accoutrements of cultivation and whatever else it took to replicate subsistence in the homeland, purportedly were carried into the islands at the outset of migration (Jones 1985). What was required to successfully implement this transplantation of the earlier economic system in the vastly different environment of the West Indies however, has not generally been considered.

A construct that is widely known as the "crab/shell dichotomy" (Goodwin 1980; Keegan 1989) is an expression of this scheme in which there is a focus on interior,

terrestrial resources by early Saladoid groups. The crab/shell dichotomy defines an apparently typical progession of settlement pattern and subsistence change in the northern Lesser Antilles and eastern Puerto Rico (Carbone 1980; Davis 1988; DeFrance 1988, 1989; Goodwin 1980; Haviser 1988; Jones 1985; Keegan 1985; Petersen and Watters 1991; Rainey 1935, 1940; cf. Siegel 1991a, b; Wilson 1989). In its most developed formulations (Davis 1988; Goodwin 1980; Jones 1985), the attributes of the complex are as follows. Generally, earlier sites were located in interior settings near water sources and on soils hypothetically better suited to crop production. There was concomitantly a reliance on large, easily procured fauna, especially species of land crab. The archaeological record seems to demonstrate that later sites were removed to the coasts of islands or away from "better" soils and nearer marine resources (cf. Siegel 1991 a, b, c). The locational change hypothetically occurred in conjuction with diminished crop production and depleted populations of terrestrial vertebrate and invertebrate fauna. At the same time, the human population was rapidly increasing as indicated by the correspondingly greater densities of sites with later occupations.

The trend in protein capture described in the crab/shell construct--from essentially land crabs and land vertebrates like hutia, to marine fish and molluscs--is at least partially correct, having been demonstrated at a

number of sites (DeFrance 1988:103; Goodwin 1980; Haviser 1988; Jones 1985; Keegan 1989; Wing 1989). Nevertheless, Wing (personal communication 1991) points out that the shift in emphasis to maritime resources may be more apparent than real. Specifically, greater consumption of marine resources during the later phases of occupation would effect a relative increase in the marine food items recovered and documented from shell midden deposits, but it does not follow that terrestrial resources went less utilized. Similarly, Siegel (1991a, b) points out that the purported accompanying change in settlement placement and density (Goodwin 1980; Wilson 1990) needs to be more firmly documented. To the same point, the hypothesized simultaneous effects during the tenure of the crab/shell dichotomy on plant production systems (Davis 1988; Goodwin 1980), and by extension, the landscape in general, or the interaction with introduced captive animals (Peterson and Watters 1991; Wing 1989), have not been documented and require detailed analyses.

Jones (1985:523-524) made the interesting case that local elimination or depletion of rice rat and land crab populations may have directly resulted from human predation and indirectly from habitat destruction caused by the clearance of woodland for swidden plots. He proceeded to estimate the amount of cleared acreage needed to produce enough manioc to support the human population (estimated from shell midden materials). Despite this interesting

effort to understand the dynamics operating on the subsistence system, Jones did not extend his interpretation to consider the long term effects of a slash and burn system of planting on the local environment in general, or the sustainability of crop production at the aboriginal level of technology.

It is a generally held (but only indirectly documented, see below) assumption of all of the models that the Cedrosan Saladoid colonists entered the island environment with their familiar complement of cultivated plants and the tools of crop production and consumption (Davis 1988; Jones 1985; Rouse 1986, 1989; Wilson 1990). Davis (1988:179), without citing the basis for his information, gives a list of eight cultigens in addition to manioc that purportedly were introduced by Saladoid people. The implication is that the gardening system previously established in lowland South America, which included domesticated plant staples as the primary source of dietary calories, was implemented in the islands.

In spite of whatever forces drove the Saladoid from one island to the next, it is likely that adjustments to the subsistence infrastructure had to be made. In one way or another, economic choices made by the colonists appear to have resulted in an unstable resource base. If the crab/shell dichotomy is at least partially true on some islands, then temporary collapses in protein sources, e.g., the local elimination of land crabs and terrestrial

vertebrates, were a problem with which island inhabitants had to contend. Two archaeologists (Davis 1988; Goodwin 1980), as mentioned above, also implicate the problem of localized crop failure as a partial explanation for the apparent shift in Saladoid settlement patterns from inland to coastal locations. However, explanations of the basis for or proofs of crop failure have not advanced beyond conjecture. The insular environment--quite distinct from the lowland tropical American areas where the horticultural system(s) originally was established--may have necessitated modifications to plant cultivation. Presently, the question of how and whether Saladoid colonists could have successfully transported their crop-production system to the insular setting has not been critically addressed. Nor have the actual types of plants and their uses been identified.

More recently, Wing (1989), DeFrance (1989) and Siegel (1991a, b, c) emphasized a more dynamic picture of settlement and adaptation on the part of Cedrosan Saladoid colonists (see also Keegan n.d.). These researchers hypothesize a growing familiarity with the insular environment that began with the initial entry of Saladoid people into the West Indies. In this view, migrants almost immediately began adding marine and other local resources to what was transported of the previously established subsistence system. Siegel (1991a:86) suggests that the Saladoid colonists were "preadapted" to the insular setting by virtue of their earlier familiarity with the aquatic

resources of the Orinoco River system and canoe travel. This second view of Saladoid existence emphasizes more immediate and direct adaptation to the insular environment, rather than the narrowly focused and probably unrealistic imposition of a mainland economic system in the island setting. Prior to the initiation of the research developed in this dissertation, inquiry into the flexibility of Saladoid adaptation has been confined to zooarchaeological data.

A final point to be made is that all of the models concerning Saladoid-Taino movement into and around the Caribbean archipelago emphasize the roles, either explicitly or implied, of plant and animal resources as central to human survival. Nonetheless, while the faunal aspect of subsistence is fairly well understood, particularly in regard to the crab/shell dichotomy (DeFrance 1988, 1989; Goodwin 1980; Jones 1985; Petersen and Watters 1991; Wing 1989, 1990; Wing and Reitz 1982; Wing and Scudder 1980, 1983; Wing et al. 1969), plant use by Caribbean Indians is only vaguely outlined.

<u>The Basis for Previous Inferences about Plant Use</u>

Assumptions about plant resources in the migration models are built primarily on two sources of information: the ethnohistoric record and artifacts believed associated with food production. Pollen data sometimes also are considered, and a few researchers (Keegan 1985; Keegan and DeNiro 1988; Van Klinken 1991) have recently introduced

osteochemical techniques into Caribbean dietary reconstructions.

Early historic chronicles describe Caribbean Indian agriculture and a few other forms of plant use, primarily in reference to the islands of the Greater Antilles (Dunn and Kelly 1988; Las Casas 1971; Oviedo 1959; and see Sauer 1966, and Sturtevant 1969). Much discussion centers on manioc, and additional mention is made of other root crops and maize. The Taino of the Greater Antilles seem to have practiced slash and burn cultivation (Oviedo 1959:13-14; Sauer 1966:51; Sturtevant 1961). In certain areas more labor-intensive forms of agriculture were practiced, including irrigated ditch networks and bench terracing (Krieger 1929; Las Casas 1909, ch.5:15, ch. 60:154; Ortiz Aguilu et al. 1991). While these descriptions of important plants, and how they were used and cultivated, are helpful, it is difficult or impossible to sort out whether individual chroniclers were describing plant production in the islands of the West Indies or on the nearby mainland. Oviedo (1959:14-15), in particular, wrote generally of Indian life in the New World, obscuring differences in plant consumption practices between groups living in the islands and those of the mainland. In addition, the early historic accounts provide no insight into the historical development of plant cultivation systems and how they were adapted to the insular setting.

The presence of tools and artifacts used to render plant foods into edible form has been used to infer indirectly the presence of cultivated plants (Davis 1988; Rouse 1986, 1992). Similarly, bone chemistry has been employed to infer diets based on certain cultivated plants (Keegan 1989). Both lines of evidence have the disadvantage, however, of not being able to point with certainty to the actual species used. Preserved plant parts are essential to solve this problem.

Various types of grinding stones have been recovered from Caribbean sites. Mortars and milling equipment are known from at least as early as the preceramic Archaic Age (ca. 4000 B.C.-A.D. 500) (Harris 1973; Rouse 1982; Veloz Maggiolo and Ortega 1976). Thus, many of these tools that often are interpreted as evidence that maize was grown (see, for example, Bullen 1964:22) and consumed predate the entry of maize into the Amazon (Roosevelt 1980; Sanoja and Vargas 1983; van der Merwe et al. 1981) and the movement of South American horticulturists into the archipelago. Moreover, since direct associations between grinding equipment and wild or semi-domesticated panicoid grass have been demonstrated for other regions of tropical America in pre-maize contexts (Callen 1965, 1967a,b; Farnsworth et al. 1985; C.E. Smith 1967; see also Newsom 1991a; Sanoja 1989), the extrapolation from grinding tools to maize and its introduction into the West Indies is not secure.

Likewise, clay griddle fragments are very common markers of Saladoid age and later sites (beginning in the first millenium B.C.) (Bullen 1964; Davis 1988; Rouse 1986, 1992). Ceramic griddles, as well as small lithic chips that may have functioned as grater-board teeth, routinely are interpreted as evidence that the Saladoid migrants began their occupation of the island environment with manioc cultivation supplying their primary source of dietary calories (see, for example, Allaire 1989; Rouse and Alegria 1990:65). While this association of griddles and grater boards with manioc may be valid, without the direct evidence of preserved plant parts, the possibility that wild indigenous roots and grains were ground, grated and processed into flour for bread or <u>tortillas</u> (DeBoer 1975) is just as likely. Therefore, the hypothesis that Cedrosan Saladoid immigrants entered the island chain with manioc as their primary staple is still in need of clarification.

Keegan and DeNiro (1988; Keegan 1985, 1987) used human bone chemistry as a reflection of diet to examine the relative importance of plant foods in prehistoric West Indian economies. Their stable isotope analysis of one Taino individual from Puerto Rico (A.D. 200-600) and 17 Lucayan Taino from the Bahamas (A.D. 600-1200) resulted in the definition of three basic dietary schemes. Four individuals, including the single Puerto Rican burial and three of the Lucayans, produced isotopic signatures strongly suggestive of a general reliance on C3 pathway foods,

probably root crops and terrestrial animal resources (Keegan 1987; Keegan and DeNiro 1988). Eleven Bahamian skeletons showed that marine-^{13}C-enriched foods were being integrated with the earlier C3-based diet. Finally, three of the Lucayan Taino (post A.D. 1200) skeletons yielded osteochemical data indicative of a diet derived primarily from plants with the C4 carbon pathway. The latter dietary signature could have resulted from heavy reliance on maize or other C4 plants and/or CAM plants, such as prickly pear cactus, which can mimic maize's isotopic signature (Shoeninger 1990; and see Farnsworth et al. 1985).

Van Klinken's (1991) isotopic analysis of human skeletal material from four locations in the Caribbean revealed the presence of three basic dietary profiles that are very similar to the patterns identified by Keegan and DeNiro. Ten individuals from Maisabel, Puerto Rico, produced carbon and nitrogen isotope values that corroborate Keegan and DeNiro's (1988) results for the Taino individual from Puerto Rico mentioned above. Specifically, Van Klinken's data indicated a diet that emphasized C3-terrestrial foods. A second group of skeletal samples consisted of ten Ceramic Age individuals (A.D. 450-980) from the closely situated islands of St. Eustatius and Saba. The isotopic data from the second sample group showed that terrestrial C3 foods, probably land crabs and root crops, were utilized, but also demonstrate that shallow marine organisms, including shellfish and reef fishes, were

regularly consumed. Van Klinken estimated that reef foods comprised between 25% and 31% of the St. Eustatius/Saba diets and that consumption of maize or other C4-pathway plants is not indicated. Similarly, Van Klinken's results for 12 individuals from the Surinam coast suggest that a balance existed in the human diet between terrestrial-C3 foods and items procured from coral reefs and sea-grass meadows. Finally, Van Klinken's fourth skeletal population--including 29 preceramic individuals from Aruba and a group of 11 Ceramic Age skeletons from Aruba, Curacao, and Bonaire--produced distinctive isotopic signatures characterized by relatively high delta-13 values (means ranging between -9.4 0/00 and -11 0/00) that approach those of extreme C4 consumers, for example, maize agriculturists. While maize production by Ceramic Age inhabitants of Curacao has been suggested based on the presence of grinding implements (Haviser 1987:52), maize is not considered to have been a part of preceramic diets. Since the isotopic values for the Archaic Age (presumably non-agricultural) skeletons and the Ceramic Age individuals from Aruba-Curacao-Bonaire are nearly identical and essentially unchanged over the broad time span (ca. two millennia), maize consumption in the Ceramic Age must have been either very limited or is not the reason for the high delta-13 values in either population. Alternatively, Van Klinken suggests that the maize-like isotope ratios probably reflect extensive consumption of shellfish and sea turtles. This

alternative to maize consumption is corroborated by the zooarchaeological remains. Thus, while osteochemical data from Caribbean sites are highly enlightening, evidence of plant and animal remains is needed to clarify isotopic signatures and further detail the dietary reconstructions.

Keegan (1985, 1987) also used pollen evidence (see below) to try and discern more detail about Ceramic Period plant use in the West Indies. At least five palynological studies of prehistoric sites on Hispaniola and Puerto Rico have been completed (Fortuna 1978, n.d.; García Arévalo and Tavares 1978; Higuera-Gundy 1991; Nadal et al. 1991; Rouse and Alegria 1990). Pollen of cultivated and otherwise useful plants were documented in some of the profiles, but the temporal placement for virtually all of the identifications is tenuous and can not be definitively attributed to prehistoric occupations. For example, maize and manioc pollen appear in sediment samples from the Hacienda Grande village site, but the pollen grains appear only in the uppermost, disturbed levels of the excavations (Fortuna n.d.; Rouse and Alegria 1990). Pollen of useful plants is absent in clearly Hacienda Grande-style deposits (Rouse and Alegria 1990:65). Simlarly, Fortuna (1978; García Arévalo and Tavares 1978:34-35) identified guava, papaya, Zamia sp. (la guayica), and tobacco pollen, among others, in samples from the site known as Sanate, eastern Dominican Republic. However, there is no direct association between the reported radiocarbon date of A.D. 1050 (Fortuna

1978:125; García Arévalo and Tavares 1978:32) and the pollen samples. A similar assemblage of pollens was identified from La Caleta, Dominican Republic (Fortuna n.d.); unfortunately the temporal placement of the pollens is not verified. At El Jobito, located near Sanate, maize pollen was recovered purportedly dating to ca. A.D. 1020 (García Arévalo and Tavares 1978:36). This identification and relatively early date needs to be corroborated with additional data. Maize pollen was identified in samples from another location on the island (bottom sediments from Lake Miragoane, Haiti [Higuera-Gundy 1991]), dating somewhere between approximately A.D. 1000 and 1500. Sanoja (1989:532) mentions an additional pair of archaeological sites in the Dominican Republic, both with maize pollen reputedly dating to ca. 1450 B.C. To reiterate, this date for maize is early and predates the first millennium B.C. migration (Siegel 1991a, c) of horticultural people into the archipelago. Nevertheless, the dates for early maize in the tropical lowlands continue to be pushed back (Miksicek et al. 1981; Pearsall 1990; Piperno 1989; Rust and Leyden 1990)--as early as 5000 B.C. for Panama--but maize is still considered to be a rather late (ca. first millennium B.C.) introduction into northeastern South America. Thus, although a second millennium B.C. date for maize in the West Indies is not unthinkable, efforts should be made to corroborate this record for the earliest presence of maize in the Greater Antilles with additional radiocarbon dates

and pollen data, as well as macrobotanical and phytolith studies. Actual maize macro-remains (cobs and kernels) have not been recovered previous to the investigations at En Bas Saline, Haiti (Chapter 6) and these date to no earlier than A.D. 1250. A previous report of maize kernels (Davis 1988) is incorrect. Large mineralized seed-like specimens from a Saladoid deposit (ca. fifth century A.D.) at the Sugar Factory site on St. Kitts were tentatively identified as maize and subsequently reported as such (Davis 1988; and see Siegel 1991b). In fact, the Sugar Factory specimens are gastroliths from the large land crabs (identified by Dr. E.S. Wing, Florida Museum of Natural History).

Nadal et al. (1991:145) have recovered compelling evidence for important plants in the pollen data from the site of Manoguayabo, near Santo Domingo, Dominican Republic. This is a relatively late site with Chicoid series ceramics (ca. A.D. 1200-1500 [Rouse 1992:107]). The pollen data indicate the presence of manioc, guava, and mombin (Spondias sp.). Macrobotanical remains (tubers, wood) of manioc and guava were recovered from another Chicoid site, En Bas Saline, dating to as early as A.D. 1250 (discussed in Chapter 6).

To summarize, Caribbean archaeologists have developed models that attempt to explain and understand Ceramic Age migrations, and the colonization efforts of Indians from lowland South America. The migration and settlement in the islands by earlier human groups has been documented, but

research has not progressed much beyond description of the sites. All of the migration models directly or implicitly invoke the importance of plant resources to the survival of the migrants. Historic documents, artifact assemblages, bone chemistry, and pollen data each have produced tantalizing, but largely ambiguous results as to the exact nature, scale, and timing of plant use. Questions remain concerning why and when the transition from subsistence based on foraging and gardening to a predominance of domesticated plants and field agriculture, as demonstrated by contact-era Taino, occurred. Moreover, the roles of indigenous wild plants, protodomesticates (e.g., primrose, as detailed in Chapters 4 through 7), and housegarden species also need definition.

Pertinent Details from Ethnohistoric Documents about Taino Plants and Agriculture

Early historic chronicles describe Caribbean Indian agriculture and plant use primarily in regard to the Taino who inhabited the Greater Antilles. Columbus's diary (Dunn and Kelley 1988) contains references to manioc and possibly also to maize. For example, on 6 November 1492 Columbus wrote: "The earth was very fertile and planted with those *manes* [manioc, *Manihot esculenta*] and bean varieties very different from ours, and with that same millet" [possibly maize] (Dunn and Kelley 1988:139). Oviedo (1959:80) related that manioc and Indian corn were important foods, but his statement applies generally to Indian life in the New World,

obscuring differences in consumption between the islands of the West Indies and nearby mainland areas.

Infrequent references to maize in historic documents pertaining to the West Indies, in conjunction with the few descriptions of its planting and use, has led to an overall impression that maize played a minor role in Caribbean Indian subsistence (Keegan 1987; Sauer 1966; Sturtevant 1961, 1969). Sauer (1966:9) summarized Taino agriculture as follows: "the main tillage is of starchy root crops which were vegetatively reproduced . . ." Manioc, by all accounts, was the principal staple and bread in the West Indies. Seed crops, including maize, do not seem to have been important to the island cultures.

The Taino of the Greater Antilles seem generally to have practiced slash and burn cultivation (Sauer 1966:51; Sturtevant 1961). Oviedo (1959:13-14) wrote:

> The Indians first cut down the cane and trees where they wish to plant it [corn]. . . . After the trees and cane have been felled and the field grubbed, the land is burned over and the ashes are left as dressing for the soil, and this is much better than if the land were fertilized.

Small earthen mounds known as "montones" (Sauer 1966:51-52) were constructed on cleared plots to provide a suitable growing platform, particularly for root crops. The mounds were circular, approximately 30 cm high and a meter in diameter. Manioc, sweet potato, beans, squash, maize, peanuts, and at least five additional rootcrops were cultivated on the mounded plots (Sauer 1966:51-54). The rootcrops are discussed in more detail in Chapter 6.

Planted tracts of montones were known as "conucos." Homegarden or "yard plants" (Sauer 1966:56-57) also are listed as having been important to Taino existance, among them are fruit trees, including mamey (Mammea americana), manzanillas (identity unknown, possibly Euphorbiaceae, used as a purgative), and other useful plants, including tobacco, cotton, achiote or anatto (Bixa orellana), calabash (Crescentia cujete), jagua (Genipa americana, the juice colors the skin black), and cohoba (Piptadenia peregrina, used as a narcotic snuff).

In limited areas more labor-intensive forms of cultivation were employed, including the use of ditch networks for field irrigation in arid southwestern Haiti (Las Casas 1909 chapter 5:15, chapter 60:154) and bench terraces in Puerto Rico (Ortiz Aguilú et al. 1991). The crops grown by means of these more intensive systems of cultivation are not known with certainty.

Previous Archaeobotanical Research on Caribbean Sites

Research with preserved plant material that could further elucidate plant use in the Caribbean is a recent enterprise in West Indian archaeology, having begun in the early 1980s. Consequently, prior to this study few data beyond what could be gleaned or inferred from historic documents and the presence of artifacts believed associated with food production were available to interpret the interaction between Caribbean Indians and their local flora.

Previous archaeobotanical studies of prehistoric West Indian deposits are limited to five sites. Pearsall analyzed material from Krum Bay, St. Thomas (1983), El Bronce, Puerto Rico (1985), and the Three Dog Site, San Salvador, Bahamas (1989a). Krum Bay, the most intensively tested of the five sites, is the only locality from which an appreciable quantity of macrobotanical remains was recovered. All three of the sites analyzed by Pearsall, however, provide good comparative wood data that can be used to examine patterns of tree selection for fuel and construction materials. I analyzed two additional sites on Puerto Rico in 1988 and 1989-1991 (El Fresal and El Parking Site, respectively [Newsom 1988, 1992a]). The preliminary analyses of the two sites have been supplemented with additional data and are incorporated in Chapter 5.

The settlement at Krum Bay (Lundberg 1989) dates to the Archaic Age, specifically the Ortoiroid occupation on the northern Lesser Antilles. A total of 2678 seeds and fragments was recovered (Pearsall 1983), 89% of which (2330 specimens) belong to two genera of the Sapotaceae that bear edible fruit--false mastic (Mastichodendron foetidissimum) and Manilkara sp. The remainder of the seed identifications from Krum Bay are primarily from weedy annuals (e.g., purslane [Portulaca sp.]) representative of ruderal vegetation.

At least 20 types of wood were identified from the Krum Bay deposits. The most ubiquitous are buttonwood

(Conocarpus erecta), white mangrove (Laguncularia racemosa), cupey (Clusia rosea), fig (Ficus sp.), cedar or roble (Tabebeuia sp.), and acacia (Acacia sp.).

Few seed remains were recovered in samples from El Bronce, Puerto Rico (Pearsall 1985), or from the Three-Dog site, San Salvador (Pearsall 1989a). Eighteen seeds representative of ten individual plant genera or families were identified from El Bronce deposits. The seeds of weedy annuals predominate, none of which is definitively associated with the prehistoric settlement. Flotation samples from the Three Dog site produced 11 fragments of plant remains with a nut-like hard seed coat. Based on the presence of whole specimens recovered with faunal samples that were analyzed at the Florida Museum of Natural History (Newsom and E. Wing, laboratory data), the seed coat fragments probably belong to mastic-bully (Mastichodendron foetidissimum).

Five woods were identified from the Three Dog site: buttonwood, lignum-vitae (Guaiacum sp.), pepper bush (Croton sp.), yellow torch or West Indian quinine bark (Exostema sp.), and false coca (Erythroxylum sp.). Twenty four different woods were recovered in flotation samples from El Bronce, including four of the same woods from Three Dog site: lignum-vitae, pepper bush, yellow torch, and false coca. Also identified in the El Bronce wood remains were what seem to be two separate species of Annona (pond-apple, soursop), sea grape/pigeon plum (Coccoloba sp.), and a caper

(*Capparis* sp.). Besides possibly having been used as fuel, several of the woody species identified have potential food or medicinal value (Little and Wadsworth 1964:344; Record and Hess 1943).

In addition to the work with systematically recovered plant remains described above, several isolated finds of plant materials and/or identifications from work of a more limited nature have been reported. From old domestic deposits inside a cave in the Dominican Republic, Veloz Maggiolo and Vega (1982) recovered leaf tissue of *Zamia debilis*, the roots of which may have been an important source of dietary starch (Sturtevant 1969), and seeds of *Clusea rosea* (an exudate from capsules of this plant reportedly have been used as a glue to set manioc grater-board teeth [Lewenstein and Walker 1984]). In addition, Veloz Maggiolo and Ortega (1976) report their recovery of carbonized hard seed coats, probably from palm seeds, in samples from at least three separate Archaic Age sites in the Dominican Republic.

Limited previous plant data are known from other islands in the Caribbean. Van der Klift (1985) identified cockspur (*Celtis* sp.) seeds in midden samples from the Golden Rock site, St. Eustatius, and Cutler (in Rouse and Alegria 1990:23) identified seeds of avocado (*Persea americana*) and yellow sapote (*Lucuma salicifolia* = *Pouteria salicifolia* = *Pouteria campechiana* [Standley and Williams 1966]) in material excavated in 1948 from the Maria de la

Cruz cave in Puerto Rico. Leaf-impressed pot sherds from Pearls, Grenada were donated to the Florida Museum of Natural History in 1985 (L. Wilder collection); the well-preserved venation and outlines of the leaf margins suggest the Melastomataceae in one case, and possibly Cordia sp. (aloewood, prince-wood; Ehretiaceae) in another.

Research Questions

In this chapter background information was presented that provides the context for this research. In the course of my discussions, six broad questions were developed.

1. What types of plant resources were integrated into the subsistence patterns of Archaic Age and later inhabitants in the West Indies and how were they integrated?
2. If exotic plant resources were imported by Archaic and/or Ceramic age cultures, what is the source area(s) for these subsistence items.
3. When and where were gardening and arboriculture undertaken by Caribbean Indians?
4. What is the nature of the interaction between Archaic Age inhabitants of the islands and the Cedrosan Saladoid colonists, and did Archaic Age people facilitate Saladoid adaptation to the insular environment?
5. When, in the transition from the Saladoid to the Ostionoid culture series, did the emphasis in subsistence systems shift from extensive rootcrop

horticulture to more intensive forms of crop production, including lengthier field preparation, irrigation, and terracing?

6. How were homegardens integrated with crop production and the overall subsistence system, and did the shift to crop production entail additions or deletions from the original set(s) of plant (and animal) foods used?
7. Was the increased reliance on cultigens such as maize and rootcrops accompanied by changes in the proportions in which other plant resources were procured?

The results of the research discussed in the following chapters will be used to attempt to answer (or at least lend some insight into) these questions. Archaeological, ecological, and archaeobotanical data are employed in my analyses. The results of this endeavor provide a more informed understanding of the development of Caribbean Indian subsistence and social complexity. Nevertheless, the products of this research have implications for the broader issues raised here and in Chapter 1.

CHAPTER 3

METHODOLOGICAL APPROACH

The data for this study were drawn from one site on the island of Bonaire, eleven sites in the Lesser Antilles, five sites on Puerto Rico, and two sites on Hispaniola (Figure 3.1). General information about the sites is presented in Table 3.1 and each is briefly described in the paragraphs that follow. Three additional sites--Macabou (Martinique), Krum Bay (St. Thomas), and El Bronce (Puerto Rico)--are shown on the map (Figure 3.1) because archaeobotanical data from the three are discussed in subsequent chapters, even though they are not part of the analyses incorporated in this dissertation.

Site Descriptions

Wanapa, Bonaire

Bonaire is culturally and spatially independent of the other sites in this study (Figure 3.1), being outside, and isolated from, the primary migratory flow of human groups from the Orinoco region into the main Caribbean Island arc. Nonetheless, the Wanapa Site is included in this dissertation because of its pertinence from a general cultural perspective and because the environment and vegetation of the island are similar enough to arid areas of

Figure 3.1: Location Map of Caribbean Sites analyzed for Archaeobotanical Data.

<u>Sites</u> - from South to North: 1 = Wanapa, Bonaire; 2 = Pearls, Grenada; 3 = Heywoods, Barbados; 4 = Macabou, Martinique, 5 = Jolly Beach, Antigua, 6 = Twenty Hill, Antigua; 7 = Indian Castle, Nevis; 8 = Hichmans' Site, Nevis; 9 = Hichmans' Shell Heap, Nevis; 10 = Golden Rock, St. Eustatius; 11 = Hope Estate, St. Martin; 12 = Beach Access Site (Lameshur Bay), St. John (U.S. Virgin Islands); 13 = Trunk Bay, St. John (U.S. Virgin Islands); 14 = Krum Bay, St. Thomas (U.S. Virgin Islands; 15 = Calle Cristo, San Juan, Puerto Rico; 16 = Maisabel, Puerto Rico; 17 = El Fresal, Puerto Rico; 18 = El Parking Site, Puerto Rico; 19 = Barrio Ballajá, San Juan, Puerto Rico; 20 = El Bronce, Puerto Rico; 21 = En Bas Saline, Haiti; 22 = La Isabela, Dominican Republic.

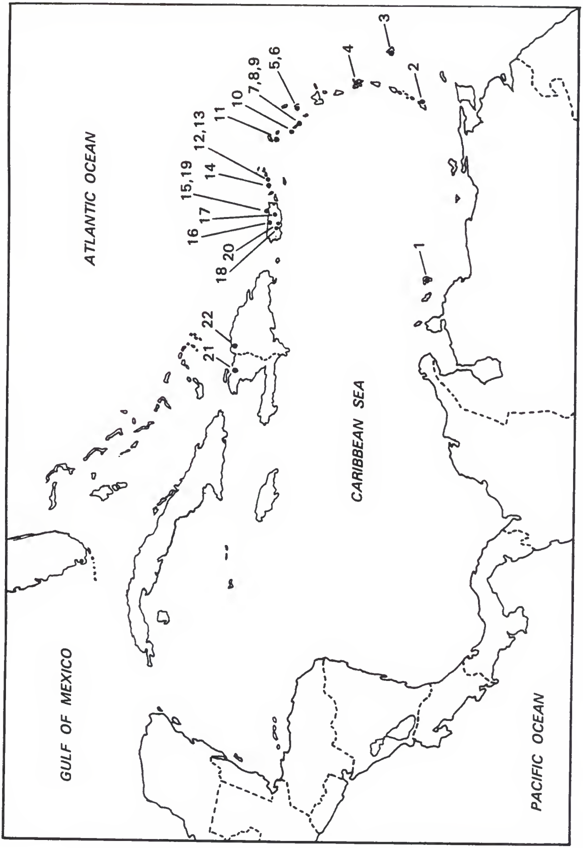

ATLANTIC OCEAN
GULF OF MEXICO
CARIBBEAN SEA
PACIFIC OCEAN
1
2
3
4
5,6
7,8,9
10
11
12,13
14
15,19
17
16
20
18
21
22

Table 3.1. Caribbean sites analyzed for archaeobotanical data.

SITE	CULTURE SERIES	NUMBER OF SAMPLES	PRIMARY RECOVERY PROCEDURE	TOTAL VOLUME (ltrs.)	WOOD WEIGHT (grams)	WOOD NUMBER IDEN.	TOTAL WOOD TYPES	TOTAL ARCH. SEEDS
Wanapa, Bonaire	Dabajuroid	45	2.8mm mesh	-	79.55	312	9	0
Pearls, Grenada	Saladoid	12	Flotation	26.50	48.78	0	0	149
Heywoods, Barbados	Troumas.;Suaz.	12	1.8mm mesh	-	18.91	13	8	0
Twenty Hill, Antigua	Ortoiroid	13	0.4mm mesh	19.00	48.27	2	2	184
Jolly Beach, Antigua	Ortoiroid	3	0.4mm mesh	0.75	(trace)	0	0	1
Hichmans' Shell, Nevis	Ortoiroid	10	Flotation	200.00	0.41	0	0	11
Hichmans' Site, Nevis	Saladoid	2	Flotation	10.00	0.40	2	2	(1)
Indian Castle, Nevis	Ostionoid	6	Flotation	6.00	1.15	8	4	(1)
Golden Rock, St. Eust.	Saladoid	50	0.4mm mesh	+-270.0	873.31	280	10	118
Hope Estate, St. Mart.	Saladoid	2	2.8mm mesh	-	84.37	40	7	0
Beach Access, St. John	Ortoir.;Salad.	2	1.8mm mesh	-	105.90	27	2	0
Trunk Bay, St. John	Salad.;Ostion.	2	1.8mm mesh	-	14.05	12	4	10
Calle Cristo, P. Rico	Saladoid	8	Flotation	1.27	25.76	4	2	0
Maisabel, Puerto Rico	Salad.;Ostion.	45	Flotation	169.86	731.80	290	8	7
El Fresal, Puerto Rico	Ostionoid	5	Flotation	151.00	67.59	60	14	458
El Parking, P. Rico	Salad.;Ostion.	35	Flotation	84.00	17.55	67	6	9
Ballaja, Puerto Rico	Historic	24	Flotation	3.91	1102.91	14	5	459
En Bas Saline, Hispan.	Ostionoid	106	Fl./0.4mm	214.55	883.42	1296	23	564
La Isabela, Hispaniola	Contact	6	0.4mm mesh	10.80	2.79	0	0	3

the Lesser Antilles to provide comparative information on resource use.

Research on the Wanapa site was directed by Jay Haviser, of the Archeologisch-Antropologisch Instituut Nederlandse Antillen (AAINA), Curaçao. The site was excavated as part of a comprehensive survey and assessment of prehistoric cultural resources on Bonaire (Haviser 1991a). Wanapa is the location of a small prehistoric settlement. The site is situated on the southern arm of the island, immediately north of Lac, the largest bay on Bonaire. The terrain is a low limestone terrace, with vegetation having a characteristically dry aspect (Stoffers 1956:18). Annual rainfall is low, averaging 500 mm, with a markedly uneven annual distribution.

Items of material culture from Wanapa have been assigned to the Dabajuroid series (Haviser 1991a). The archaeological deposits at the site are rather homogeneous, lacking clear evidence of stratification. Thus, according to Haviser, even though the radiocarbon dates range widely (from ca. A.D. 470 to A.D. 1450), a single continuous occupation is suggested. A steady accumulation of refuse was produced by the site's inhabitants, including the remains of plant resources. All plant remains from Wanapa probably represent secondarily deposited materials, such as fuelwood remains and hearth sweepings that were removed from primary contexts and subsequently incorporated in the midden-refuse areas. Nothing that could be definitively

identified as a cooking area or hearth was encountered during excavation.

The plant remains were recovered from ten 2 x 2 meter excavation units that were placed in two separate locations at the site. Area A is a general midden or refuse deposit (eight excavation units), and excavation Area B includes the floor of a circular house and an associated concentration of dense midden on its southwestern perimeter. Several archaeobotanical samples were recovered from the house-associated midden.

Pearls, Grenada

Pearls, on the island of Grenada at the southern end of the Lesser Antilles (Figure 3.1), is the site of a large Cedrosan Saladoid village estimated to have originally covered at least 25 to 100 acres (Bullen 1964:18-22; Cody 1990, 1991; Keegan 1993; Keegan and Cody 1990). The site is located on the northeast coast of the island on a flat plain near the mouth of the Great River. Grenada is a volcanic island with good agricultural soils and abundant rainfall.

Recent test excavations (1988-1990) at Pearls were conducted by William F. Keegan (Florida Museum of Natural History) and Annie Cody (University of California, Los Angeles). Archaeobotanical samples from Pearls derive from the rather extensive shell midden deposits (Keegan 1993; Keegan and Cody 1990).

An unfortunate circumstance is that the site has suffered much disturbance to what otherwise were well-

preserved deposits with good organic preservation. The modern intrusions have resulted not only in the loss of important contextual information, but plant remains were undoubtedly negatively impacted by disruption of the burial environment.

Archaeobotanical samples from Pearls come primarily from two excavation units, designated West 195.5 and West 196, that were placed in an undisturbed area of the site. Both units penetrated intact shell midden with abundant, well-preserved faunal remains. The ceramics and other artifacts from West 195.5 and West 196 are exclusively Saladoid; in particular, ceramic griddle sherds and undecorated pottery were frequent, suggesting that the area was the location of common domestic activities (household deposits unassociated with ceremonial areas of the site).

<u>Heywoods, Barbados</u>

Heywoods site is located on the western side of Barbados, a flat coral island in the southern Windward Islands, and the easternmost of the Caribbean islands. Rainfall on Barbados is ample, at about 1500 mm annually (Mohlenbrock 1988), but the soils are generally poor for plant cultivation.

Shell midden deposits at the Heywoods site accumulated during the Suazoid and earlier Troumassoid occupations of the island (ca. A.D. 600-1400). Excavations at Heywoods were conducted under the direction of Peter Drewett (Institute of Archaeology, University College London,

England) in cooperation with the Barbados Museum. The archaeobotanical samples consist of shell midden deposit from general excavation levels (Table 3.1), collected in excavation screens of 1.8 mm (1/16 inch).

Twenty Hill (PE-19) and Jolly Beach (MA-3, MA-4), Antigua

Antigua is a sedimentary (as opposed to volcanic) island located midway up the Lesser Antilles, in the southern Leeward islands (Figure 3.1). Two sites on Antigua attributed to the Archaic Age Jolly Beach culture (Ortoiroid culture series, ca. 1000-2000 B.C. [Rouse 1992]) have yielded limited archaeobotanical data. Twenty-four sites attributed to the Jolly Beach culture have currently been documented on Antigua; all are situated along the coast, primarily on the northern half of the island, where, according to Rouse (1992:65) fishing and shellfishing are more readily undertaken.

Recent excavations at the two sites that produced the archaeobotanical samples analyzed below were carried out by Bruce Nodine in conjunction with research directed through Brown University. Radiocarbon dates from the Twenty Hill deposits place the occupation of the site between approximately 500 B.C. and 3000 B.C. (Nodine, personal communication, August 12, 1989). However, inconsistencies in the radiocarbon dates and the presence of deeply buried historic artifacts indicate that the site is disturbed. Nevertheless, Nodine (personal communication, ibid.) feels certain that the carbonized plant specimens discussed in

Chapter 4 are indeed associated with the prehistoric occupation. As with Heywoods and Wanapa, samples from the Antigua sites represent general excavation fill (5 cm arbitrary levels) that was sieved through 1/16 inch sceens.

Hichmans' Shell Heap (GE-6), Hichmans' Site (GE-5), and Indian Castle (GE-1), Nevis

Shell midden samples from three sites on Nevis were analyzed for the presence of plant remains. The excavations and research at the sites were part of an intensive settlement survey directed by Samuel M. Wilson, University of Texas, Austin. The current archaeobotanical analysis is limited, with the objective of assessing the potential for paleoethnobotanical research on the island.

Nevis is a volcanic island centrally located in the Leeward island group (Figure 3.1). Rainfall is adequate, ranging from 1000 mm on the windward coast to approximately 2500 mm on Nevis Peak (Wilson n.d.). All three sites are located on the southeast coast of the island, near the most extensive series of coral reefs (Wilson n.d.).

Human groups inhabited Nevis at least as early as the Caribbean Archaic Age, and essentially the whole range of prehistoric human occupation on Nevis is represented by the three sites analyzed for archaeobotanical data. Hichmans' Shell Heap (GE-6) is a preceramic Ortoiroid site dating to the last millennium B.C. (radiocarbon age: 540$\pm$60 B.C. (2490$\pm$60 B.P., Beta-19328) (Wilson n.d.). Nearby Hichmans' Site (GE-5) represents an early Saladoid people, based on the presence of Zone-Incised-Crosshatched-decorated ceramics

(Wilson n.d.). The third site, Indian Castle (GE-1), was occupied during the subsequent Ostionoid period (approximately 600 A.D. to the time of European contact). Indian Castle is the largest Ostionoid site on Nevis; a single radiocarbon date of 670±60 A.D. (1280±60 B.P., Beta-19327) was obtained for the site (Wilson n.d.).

Archaeobotanical samples from the Nevis sites are primarily from the refuse deposits; three samples from Indian Castle come from a pit feature and pair of post molds. All samples from the sites were processed by means of water flotation.

Golden Rock, St. Eustatius

Golden Rock is a large early Saladoid settlement (80 cal B.C. to 980 cal A.D.) centrally located on the volcanic island of St. Eustatius (Versteeg and Schinkel 1992). St. Eustatius is near Nevis (Figure 3.1) and has a similar rainfall regime, averaging between 1100 mm and 2000 mm annually. There are no permanent sources of freshwater on St. Eustatius (Boldingh 1909).

Recent excavations at Golden Rock were directed by Aad Versteeg and Kees Schinkel of the Rijks Universiteit, Leiden, with the support of the St. Eustatius Historical Foundation and the AAINA, Curaçao. Careful excavation produced the first complete floorplans of prehistoric houses in the Caribbean Islands. In addition to discerning the outlines and floors of at least five Saladoid houses and other wooden structures, the excavations revealed the

presence of associated large midden accumulations and a plaza area.

Plant remains are exceptionally well preserved in the Golden Rock deposits. Carbonized wood from the house posts and archaeobotanical samples from the shell midden deposits provided information about wood use and plant foods (Chapter 4). Materials from this site were recovered by means of dry sieving through fine meshes (see below) and by direct collection of larger-sized wood remains.

Hope Estate, St. Martin

Ongoing excavations at Hope Estate are being carried out under the direction of Jay Haviser (AAINA, Curaçao), and Corinne Hofman and Menno L. P. Hoogland (Rijks Universitat, Leiden), with the support of the Association Archeologique "Hope Estate." St. Martin is partially volcanic, associated with the outer (northeastern) arc of uplifted sedimentary formations in the northern Lesser Antilles. The Hope Estate site is located approximately 2 km inland in a major drainage valley with a semi-permanent flow of fresh water (Haviser 1988). The island receives about 1000 mm of rainfall annually.

Like Hichmans' Site and Golden Rock, Hope Estate is an early Ceramic Age settlement. Radiocarbon dates range from approximately 560-350 B.C. (2510$\pm$40; 3200$\pm$55 B.P., University of Pennsylvania) at the earliest, to approximately A.D. 435-460 (1515$\pm$35, 1490$\pm$35 B.P., University of Pennsylvania) (Haviser 1988). Haviser (1988)

has suggested that three separate prehistoric cultural groups may have occupied the site, the first being an early ceramic-bearing group who produced zoned-punctated and curvilinear-incised ceramics. This first group of people are believed responsible for a small shell midden deposit (designated XXII T20-T21, see Chapter 4) and the earliest portion of a second (Haviser's "primary" midden) shell midden (designated XVII A1-A5). The second possible culture to appear at the site is identified with the Cedrosan Saladoid series; typically red-painted, white-on-red, and red-and-black painted ceramic wares were recovered in association with levels attributed to this second occupation, along with some Huecan-Saladoid decorative elements (Haviser 1988). The second occupation continued to deposit materials on the primary shell midden. Haviser refers to the third cultural unit tentatively recognized for Hope Estate as "modified Saladoid" people; they are believed to have ties to the mainland Barrancoid tradition (Haviser 1988).

Archaeobotanical samples from Hope Estate were obtained from shell midden deposit by stratigraphic excavation using 2.8 mm excavation screens. The samples represent excavation levels, rather than specific features or other more discrete deposits. Currently only two such samples have been completely analyzed (Chapter 4), both come from the earliest occupation of the site (Haviser's Early Ceramic group).

Beach Access Site and Trunk Bay, St. John, United States Virgin Islands

The island of St. John occurs in the Virgin Island group at the northern and western most extent of the Lesser Antilles. Salvage operations at the Beach Access Site (also known as Lameshur Bay) and at Trunk Bay were conducted by Ken Wild of the National Park Service, Southeast Archaeological Center. The material culture assemblage from the Beach Access Site indicates the presence both of the Archaic Age Ortoiroid and the later Huecan Saladoid culture series. Radiocarbon dates from the site range from approximately 730 B.C. to the first centuries A.D. (Ken Wild, personal communication, 17 December 1992). The Trunk Bay deposits represent a later occupation(s), with the presence of Cedrosan Saladoid and Ostionoid ceramics series.

Limited archaeobotanical analysis of samples from the two prehistoric sites was undertaken. Nevertheless, data useful to this dissertation research were gathered. Samples from the Beach Access Site derive from a pair of burned areas that may have functioned as hearths. Trunk Bay samples come from general or undifferentiated refuse (shell midden) deposits.

Calle Cristo, Puerto Rico

Archaeological research at Calle del Cristo, San Juan, was conducted during 1989-1991 by the Puerto Rico State Historic Preservation Office under the direction of Carlos Solis Magana and Virginia Rivera. The prehistoric site is located beneath present Calle del Cristo and extends to an

area adjacent to Calle Norzagaray. Ceramics and other artifacts indicate that the deposits at Calle del Cristo belong to the period associated with the Cuevas/Cedrosan Saladoid subseries. Several midden strata were analyzed for the possible presence of preserved plant structures.

Maisabel, Puerto Rico

Maisabel is located on the north coast of Puerto Rico west of San Juan near the town of Vega Baja (municipality Manati). The site was intensively investigated during the latter part of the 1980s under the auspices of the Centro de Investigaciones Indigenas de Puerto Rico, Inc. and with the direction of Peter Siegel.

Maisabel is a large prehistoric village that appears to have been continuously occupied for an extensive period, spanning at least several centuries. Radiocarbon dates for good cultural contexts from Maisabel range from at least as early as 100 B.C. to approximately A.D. 1100 (see Siegal 1990 for an in depth discussion of radiocarbon calibrations for Maisabel). The coastline forms the northern boundary of the site and a small pond is situated on its southern perimeter; immdediately to the east is a large mangrove swamp, and one kilometer further east is the Rio Cibuco.

Archaeological research demonstrates that Maisabel is structurally and culturally complex. Particularly salient features of the site include a series of five mounded midden areas that encircle a large central plaza and burial area; located between the two largest mounded middens is an area

where a substantial Ostionoid structure stood (Siegel 1989; 1990). Burials were also confined within the large Ostionoid building. Mounded Midden 1, from which was analyzed the greatest number of archaeobotanical samples, dates exclusively to a Hacienda Grande-Saladoid occupation. Other samples came from Mounded Midden 2 and the large central plaza and burial area; these portions of the site seem to have been used continuously from Hacienda Grande to Ostionoid times. Immediately south of the plaza/burial area is the large, circular Ostionoid-aged house or ceremonial building; the structure was circumscribed by a curving, discontinuous ditch feature (Siegel 1989, 1990). At least five archaeobotanical samples are associated with the Ostionoid building and ditch feature.

Two types of archaeobotanical sample were recovered from Maisabel deposits. One group of samples consists exclusively of collections of carbonized wood. These represent either concentrations of wood fragments that were collected directly as batch samples as they were observed *in situ*, the same procedure as was employed for large wood remains from Golden Rock, or wood collected by the excavation screens. Most of these separate wood collections, referred to as "carbon samples", derive from general-level deposit (screened material); seven were recovered directly from features, e.g., hearths, or possible postholes, or other distinctive types of deposit.

The second group of samples from Maisabel are volumetric soil samples. These were processed initially by water flotation. Like the carbon samples described above, some volumetric samples represent general-level deposit while others derive from more specific contexts. Siegel's sampling strategy included the routine collection of ca. 10 liter volumetric samples. Whenever possible, at least one such sample was recovered from each excavation level or context (Siegel 1987), including features and other more specific contexts that may have been enountered within a given 10 cm excavation level.

El Fresal, Puerto Rico

El Fresal is an Ostionoid series site located in south-central Puerto Rico, barrio Cuyon, municipality of Aibonito. Excavations and research on the site were directed in 1988 by Marisol Meléndez for the Rural Development Office of the Agriculture Department.

The site is situated approximately 30 kilometers inland at the northern edge of the southern dry coastal region (Ashton 1985), bordering the lower cordillera forest. El Fresal seems to have been the location of a small prehistoric settlement. A single radiocarbon date of A.D. 1160±60 (790±60 B.P., Beta-26326) is consistent with items of material culture from the site (Meléndez 1988); the ceramics and other artifacts are indicative of the Ostionoid series, including the Ostiones and Santa Elena complexes,

and also the later Esperanza, Capa, and Boca Chica styles of eastern and western Puerto Rico (Rouse 1992).

Several fairly large hearth-like burned deposits were excavated by Meléndez, and samples from three of the hearth-like deposits were analyzed for plant remains. All such archaeobotanical samples were initially processed by water flotation.

El Parking Site (PO-38), Puerto Rico

Deposits at the El Parking site (PO-38) belong to a late Saladoid, specifically Cuevas, to early Ostionoid occupation located in south-central Puerto Rico in the Cerrillos River Valley (Sector Los Fondos, barrio Maraguez, Municipio Ponce). Excavations at the site were conducted during 1989 and 1991 by Guy G. Weaver of Garrow and Associates, Inc., Memphis, Tennessee.

The El Parking site is situated at the north end of an alluvial terrace at the base of the steep western valley wall, and approximately 15 kilometers north of the southern coast of Puerto Rico (Weaver 1992). Physiographically, the site is situated in a transitional zone between the Cordillera Central and the low Coastal Plain (Weaver 1992).

Old living floors and hearth-like deposits were uncovered in the course of excavations; several of these features were tested for the presence of archaeobotanical remains. All samples were initially processed by means of water flotation. Features 14, 17, and 34--samples from which are included in the analyses presented in Chapter 5--

have corrected radiocarbon ranges (1 sigma) of A.D. 652-851, A.D. 541-666, and A.D. 656-855, respectively.

Barrio Ballajá, San Juan, Puerto Rico

Archaeobotanical samples from nineteenth-century deposits in Old San Juan, barrio Ballajá, contain exceptionally well preserved plant remains. Despite the considerably later age than most of the plant assemblages included in this study, the Ballajá materials are incorporated here due to the fact that several of the plant identifications currently represent the earliest record for the presence in the Caribbean of the particular genera.

Phase II and subsequent investigations in the barrio by the Puerto Rico State Historic Preservation Office (under the direction of Carlos Solis Magana and Virginia Rivera) established the existence of substantial, intact deposits and features dating primarily to the Eighteenth and Nineteenth centuries. Among the significant cultural deposits were refuse pits, buried barrel wells filled with refuse, former latrines, preserved floors, and architectural remains. Most of these deposits and structures could be associated by documentary evidence with individual households (Solis Magana, personal communication, March 1992).

Portions of ten features that variously originated with nineteeth-century households were analyzed for archaeobotanical data. Among these is Feature 25 which functioned as a latrine for a relatively high status family.

Additional archaeobotanical samples derive from Feature 57, a hospital disposal area and latrine. Plant materials from barrio Ballajá were recovered primarily by means of water flotation; archaeobotanical data from the flotation samples are augmented, however, with identifications of plant materials that were captured in excavation screens.

En Bas Saline, Haiti

En Bas Saline is located about one kilometer inland from the beach-side village of Limonade Bord de Mer, Haiti, and about 15 kilometers east of present-day Cap Haitien. Kathleen A. Deagan of the Florida Museum of Natural History at the University of Florida has carried out six field seasons of excavation at the site (1983-1988) in collaboration with the Bureau National D' Ethnologie D' Haiti.

En Bas Saline is believed to have been the town of the Taino cassique Guacanacaric, who provided Columbus with assistance and refuge after the wreck of his flagship, the Santa Maria, in 1492. It was at the town of Guacanacaric that Columbus established the fortification known as La Navidad (Deagan 1986, 1987). Upper levels of the site contain small quantities of European artifacts and fauna (Sus scrofa and Rattus rattus) that together with other data support arguments for its identifification as the town of Guacanacaric.

Radiocarbon dates, pottery thermoluminescence dates, and the position of the European materials indicate that En

Bas Saline was first occupied at about A.D. 1250 (cal AD 1270+-80) and abandoned within a decade of A.D. 1500. The aboriginal materials are exclusively Carrier, a style characteristic of the fully developed Taino Indian culture (Rouse 1986, 1992). The site is an oval-shaped village, described by a wide, raised earthen embankment around its northern perimeter, and a band of concentrated midden debris around the southern half. The center of the site is relatively free of debris and apparently functioned as a plaza. A small raised mound in the center of the plaza area contained the remains of what was a large and substantial structure that burned in the Fourteenth Century. By all ethnohistoric accounts, such structures were occupied by Taino chiefs.

With an area of nearly 200,000 square meters, En Bas Saline is one of the largest prehistoric towns reported from the Caribbean. Documentary accounts, as well as the site's size, its configuration around a plaza, the central mound and the richly ornate material remains, all suggest that it represents the town of a Taino chief.

Archaeobotanical samples from En Bas Saline were taken from various deposits representative of the full temporal range of occupation at the site. Additional details about the cultural contexts and the nature of the archaeobotanical samples are fully detailed in Chapter 6.

La Isabela, Dominican Republic

A limited number of samples were analyzed from La Isabela, the last of the sites incorporated in this dissertation. Isabela, on the north coast of the Dominican Republic, is the location of the colony established in 1494 by Columbus on his second voyage to the West Indies (Deagan 1988). Recent excavations at the site were carried out by Kathleen A. Deagan (Florida Musem of Natural History) and Jose M. Cruxent (Venezuela). Most of the samples from Isabela are from the floor of a single house; two additional samples come from the floor of another structure and from a Spanish burial.

Archaeobotanical Methods

Sample Comparability

Archaeobotanical samples from the various Caribbean sites differ in the ways in which the materials were originally deposited and subsequently recovered by archaeologists (Table 3.1). Moreover, the inherent durability or lack thereof of the various types of plant tissues, along with specific factors of the local preservation environments combine to affect long-term preservation.

This situation makes it difficult to compare sites and individual samples. Nevertheless, to search for patterns of plant use in the Caribbean assemblages, I examined the distribution of seeds, wood, and categories of plants (e.g., ruderals, fruit trees, homegarden species) by sample, by

site, and by chronological context. Probably the most notable characteristic of the overall sample assemblage is a lack of consistency from one sample to another in both the types of plants present and the relative abundances of those plants. Some samples had no seeds; others had seeds but no identifiable wood; some yielded isolated specimens of a single seed or wood type; and others had large quantities of wood or of a particular seed type or category (e.g., seeds of ruderals). Still other samples yielded an array of potentially edible or useful plant types. It is possible in this early stage of archaeobotanical research that the general disparity in the distributions of seeds and wood is a result of the lack of redundancy in the data, or an artifact of sampling. Despite these problems and regardless of the vagaries of preservation and the need to analyze more material, it was possible to detect some spatial and temporal patterns within and between subregions.

Sample Preparation

Upon excavation archaeobotanical samples were either sent directly to me for further processing and analysis, or they underwent preliminary separation and sorting by the archaeologists prior to my receiving them. All samples from the Puerto Rico sites were processed by water flotation, and in most cases large wood fragments were extracted *in situ*. The treatment of samples and materials is less uniform for the Lesser Antilles sites (Table 3.1), samples from some sites having undergone flotation, while those from others

were sieved with meshes ranging from 2.3 mm to 0.4 mm. Golden Rock samples were collected either directly, in situ, or fine-sieved through 0.4 mm mesh. Several separation procedures were experimented with in regard to En Bas Saline and Isabella, and dry sieving though fine meshes (4.0 mm to 0.4 mm) appears to have been most appropriate to recover plant remains. Given the overall disparity in sampling and separation procedures among the site assemblages, quantative measures of relative importance, including counts, relative frequencies, and ubiquity (see below) were employed on an individual site basis only. Broader comparisons are based on presence/absence and general spatial and temporal distributions.

Samples from most of the sites were preliminarily processed, either by flotation or sieving procedures, prior to sending the materials to the laboratory at the Florida Museum of Natural History for analysis. Sites for which the archaeobotanical samples were preprocessed include Wanapa, Heywoods, Hope Estate, the Nevis sites, Beach Access, Trunk Bay, and all the Puerto Rico site assemblages. Samples from Pearls, Twenty Hill, Jolly Beach, Golden Rock, En Bas Saline, and Isabella were bagged upon excavation and not otherwise processed prior to arrival in the laboratory in Gainesville.

The sorting and analysis of preprocessed samples began immediately. Any samples that were forwarded to me unprocessed, that is, without having undergone prior sorting

and separation procedures, were first evaluated as to their general condition, soil type, and the durability of the plant materials contained within. This preliminary assessment is necessary to assess the appropriateness of flotation or other types of sample preparation. Initially all samples were weighed and the volume recorded, even if the samples were recovered by standardized volume. Flotation at the Florida Museum was carried out using a SMAP-type flotation machine (Watson 1976) and tap water. In most cases, light and heavy fractions from the flotation procedure were examined and sorted directly, without additional sample preparation. Alternatively, light and heavy fractions from samples that yielded greater quantities of plant remains were sieved through 4 mm, 2 mm, and 1 mm meshes (with bottom pan) to size-grade the materials (partitioning the samples by particle size facilites sorting and analysis).

Samples from some sites, especially those found in more arid environments, were judged unsuitable for water flotation due to the prevalence of wood remains and/or the friability of plant specimens. In any situation, samples with clayey soil matrix were generally always water-floated. Samples that did not undergo flotation were sieved directly through a nested sieve series, resulting in four mesh-size components per field sample: 4 mm, 2 mm, 1 mm, and 0.4 mm. The mesh sizes are generally consistent with standard archaeobotanical technique (see for example Greig 1989).

The sieving alternative to flotation was done either dry or with a fine spray of water depending on the moisture content of a given sample. Moderately moist to wet soil matrix was processed with water; dry to very dry samples were sieved dry. These procedures facilitated sieving and the size partitioning of sample components while maintaining the sample moisture content as near equal as possible, thus avoiding the additional stress upon fragile plant remains of total immersion and subsequent drying (see Vaquer et al. 1986). (Carbonized plant remains from dry or alternately wet/dry deposits quickly fragment along linear planes into numerous pieces when exposed to water, even from percolation across a damp towel [laboratory observations].)

In several cases, e.g., Golden Rock and Maisabel, carbonized wood specimens were collected directly, without subjecting the specimens to further sample preparation and possible breakage. Archaeobotanical samples that underwent water-sieving or flotation were allowed to dry slowly in a sheltered area prior to analysis.

The sample fractions from the sieving or flotation procedures were further sorted and categorized with the aid of a dissecting microscope. Materials from the 4 mm and 2 mm size fractions were completely sorted. Residues from the finer sample components (1 mm and 0.4 mm meshes) were scanned under the microscope for seeds and other identifiable plant material, but were not otherwise sorted. The 0.4 fraction proved generally unproductive of useful

plant data; generally, only fungi spores (e.g., wood rotting fungi, for example, Polyporous spp.) were observed in this sample fraction. Other than wood charcoal and occasional seeds or fragments, virtually all plant remains from the Caribbean sites were recovered in the 1 mm sieve fraction.

Plant Identification

Seeds and non-wood remains

Seed identifications were made with the aid of pictorial guides (Chase 1964; Landers and Johnson 1976; Martin and Barkley 1973), local floras (Little and Wadsworth 1964; Little, Woodbury, and Wadsworth 1974; Liogier and Martorell 1982), and by reference to specimens in the collections of the Florida Museum of Natural History. Seed measurements were made using a dissecting microscope with either a Manostat manual-dial caliper or a Fowler Ultra-Cal II digetal caliper. Maize remains were measured and analyzed following Bird (1990) and King (1987). Tubers were classified and/or identified on the basis of morphology and anatomy using comparative specimens and literature such as Esau (1977), Hather (1991), Hayward (1938), Jackson and Snowdon (1990), and Onwueme (1978). On occasion, modern seed specimens were carbonized for comparative purposes. Identifications were made to the nearest recognizable taxon. In some cases individual archaeological specimens were described, but not further identified because of insufficient material or the lack of suitable comparative specimens. The category "unidentified soft tissue" refers

to burnt, amorphous bits of material that in some cases may represent wood exudate, and in others, unrecognizable fragments of parenchymatous tissue.

Modern seeds were routinely identified to help define the Caribbean weed flora and to anticipate which seed types might be expected to occur in association with human activity. Moreover, the identification of modern specimens is occasionally helpful to interpret the presence in a site of questionably ancient seeds (Miksicek 1987). In other words, if a particular seed type from a given site occurs in both carbonized and in fresh form, it is probable, though not certain, that the charred specimen also is relatively fresh and intrusive into the deposit (and see below). It does not follow, however, that the lack of a corresponding non-carbonized specimen at a site is evidence that a particular carbonized seed or seed type is archaeological.

Wood identification

Wood was identified on the basis of three-dimensional anatomy under magnifications ranging between 40x and 1000x. Individual charcoal specimens were prepared for anatomical inspection by fracturing each along three surfaces (cross, radial, and tangential). Following this, the cellular structure of the charred wood fragments was observed and documented with the aid of a dissecting microscope with enhanced magnification (200-800x). Similarly, waterlogged wood from En Bas Saline was prepared for identification by mounting thin sections onto glass slides, which then were

observed using light microscopy. Scanning electron microscopy occasionally was employed for difficult identifications.

Wood identification proceeded with the use of keys to anatomical structure (Newsom, laboratory key for Caribbean woods; Record and Hess 1942-1948; Urling and Smith 1953; Wheeler et al. 1986). Wood types were further narrowed by direct comparison of the cellular structure in carbonized form with the anatomy observed in wood thin-sections from modern specimens housed in the Florida Museum of Natural History. All identifications were pursued to the closest recognizable taxon. Usually this was to the level of genus, since wood anatomy tends to provide insufficient information to perform identification to the level of species.

A dissecting microscope also was used to observe growth rings on wood specimens from the Golden Rock site. Ring width measurements were made on the microscope with a Manostat dyal-type caliper. Angle of growth-ring curvature and stem diameters were estimated with a rim-diameter template (commonly used for ceramics analysis).

Following identification, floras and vegetation studies were consulted for geographic distribution and other ecological and taxonomic details. Among the treatises used were Boldingh's (1909) and Stoffers's (1956) studies of the vegetation of the Netherlands Antilles, along with Broeders' (1967) handbook on the vegetation of Aruba, Bonaire, and Curacao, and Coomans and Coomans-Eustatia (1988) on St.

Martin. Ewel and Whitmore (1973), Little and Wadsworth (1964), Little and Woodbury (1976), Little, Woodbury and Wadsworth (1974, 1976), Liogier and Martorell (1982), and Woodbury and Little (1976) were consulted for the vegetation of Puerto Rico, the Virgin Islands, and generally the northern Lesser Antilles. Beard (1942, 1949), Howard (1974-1989), Holdridge (1947, 1967), and Record and Hess (1943) provide regional perspectives on the native flora. The entire spectrum of plant identifications from this research is listed in Appendix A by taxonomic level.

Comparative Measures

Minimum number of wood specimens identified

Previous research has demonstrated that a minimum number of at least 30 fragments of wood identified per sample is necessary before the relative importance of individual wood types in a given provenience can be estimated (Newsom 1991a; Scarry and Newsom 1992; and see below). Ideally, the minimum-identified figure should be determined separately for each site and context under study. Generally, plots of wood (the ordinate) from sites in South Florida and the Caribbean level out and become redundant as to new species added when between 20 and 30 specimens (the abscissa) is reached. However, the relative frequencies of different woods in a given sample tend not to stabilize, and thus do not function as reliable indicators of relative importance, until a count of about 30 to 40 specimens per provenience is established (see Scarry and Newsom 1992).

The objective of 30 wood fragments minimum identified was followed here, but many samples did not contain 30 fragments of identifiable wood.

Counts and ratios

Whenever possible seed counts were based on whole specimens; otherwise, fragment counts are reported and indicated as such. Whenever possible, fragments count reports include also an estimated minimum number of specimens, based on the presence of seed placental scars or hila (one per individual seed), is also reported.

In most cases, total seed counts were standardized by sample volume. The resulting ratio is useful to examine the overall seed densities in site deposits and for comparisons between proveniences. Similarly, wood gram weight per liter of sample is used to compare wood densities from one sample to the next. The ratios valuable also to compare the relative importance of species within and between sites, at least on a rudimentary level. Using volume as the standard, however, necessitates that the ratios are suitable only for sites with good preservation, because poor preservation of organic remains could potentially skew the data. An additional consideration in this regard is that the original, pre-flotation sample volumes are not available for Ballaja or Calle del Cristo. Instead, the sample volumes recorded for these two sites are the light fraction volumes, subsequent to flotation. Thus, in the case of these two sites, the seed counts reported in Chapter 5 are actually

measured against the volume or density of carbonized wood remains, which comprise the bulk of the plant materials. Since the amount of wood can vary greatly among samples, depending on the nature of the deposit, preservation, and other factors, these ratios should be regarded judiciously and can not be used in comparison with data from the other sites.

Archaeobotanical ubiquity

Ubiquity is a measure used by archaeobotanists to interpret the relative importance of different plants among inter- and intrasite plant assemblages (Pearsall 1989b; Popper 1988). This method expresses the number of samples in which a given plant identification appears as a percentage of the total number of samples. Each wood type, for example, is scored as being present or absent for each sample provenience regardless of how many individual fragments of the wood occur. By applying the same emphasis on one as on ten fragments, for example, the problem of interpreting species importance in light of differential breakage and preservation is avoided. Wood types or seeds that are more prone to break into numerous pieces may appear deceptively more important in a given sample; archaeological ubiquity overcomes this difficulty of interpretation by directing attention away from actual counts to overall representation at the site or sites.

Preservation Biases

Another means by which plant remains from archaeological sites are considered and classified is in terms of which plant types actually appear in the deposits as the result of past human activities or otherwise occurred at the time the deposits formed, versus those seeds and plant fragments that are modern and of no consequence to archaeological interpretation. Generally, archaeobotanists working with terrestrial deposits use the condition of carbonization--whether or not a given specimen is carbonized--to help interpret the seed's or wood's validity as an archaeological specimen. An underlying assumption is that only biologically inert carbonized seeds/wood could survive lengthy periods and thus may be attributed to the period of site formation and deposition (Miksicek 1987). Uncarbonized specimens, on the other hand, tend to be classified as recently intrusive into the archaeological sediments and thus not pertinent to archaeololgical interpretation. Nevertheless, this rule must be applied with latitude, particularly for younger deposits such as were tested by the Ballaja Archaeological Project. Furthermore, conditions exist under which non-carbonized seeds and plant parts may endure longer, particularly where anerobic deposition occurs (for example, in the bottom of a well or pond), under extremely arid conditions, and/or where mineralization of seeds is possible.

Very moist sediments were encountered in the deeper excavations of latrine deposits at Ballaja and at the water table during excavations at En Bas Saline. In both cases, plant remains were preserved in uncarbonized form by means of waterlogging (anaerobic environment). Seed preservation by mineralization, perhaps in conjunction with soil chemistry and varying moisture conditions (Green 1979), seems also to have occurred at several Caribbean sites. Therefore, in terms of this research, attention was directed not only toward whether or not plant materials were carbonized, but also carefully considered was the general state of preservation and association with other plant materials. Modern, very recently intrusive seeds were subjectively recognized on the basis of how fresh and intact seed coats and other parts appeared, and, on occasion, also by sectioning seeds to inspect for presence and the condition of embryos and other seed contents (which rapidly undergo diagenesis and decay in the burial environment).

CHAPTER 4

RESULTS OF ARCHAEOBOTANICAL ANALYSES: LESSER ANTILLES AND BONAIRE

The results of research with collections of plant remains from archaeological sites in the Lesser Antilles are described in the following sections. Discussed are collections from three sites located in the Windward Island group, including one site on the geographically isolated island of Bonaire, and from nine sites in the Leeward group of the Lesser Antilles (Figure 4.1).

Windward Islands and Bonaire

Wanapa, Bonaire

Although Bonaire is outside the general flow of migratory prehistoric human groups through the islands of the West Indies (Rouse 1986, 1989, 1992), the Dabajuroid Wanapa site is the first of prehistoric settlements located in the small western island group of Curaçao, Bonaire, and Aruba to be subjected to paleoethnobotanical scrutiny. Thus the analyses of plant materials are included here. Moreover, the data are relevant to a general understanding of prehistoric adaptation and human influence in the region.

Because plant remains from the Wanapa Site were isolated from the archaeological deposits using 2.8 mm-mesh screens, archaeobotanical specimens recovered consist

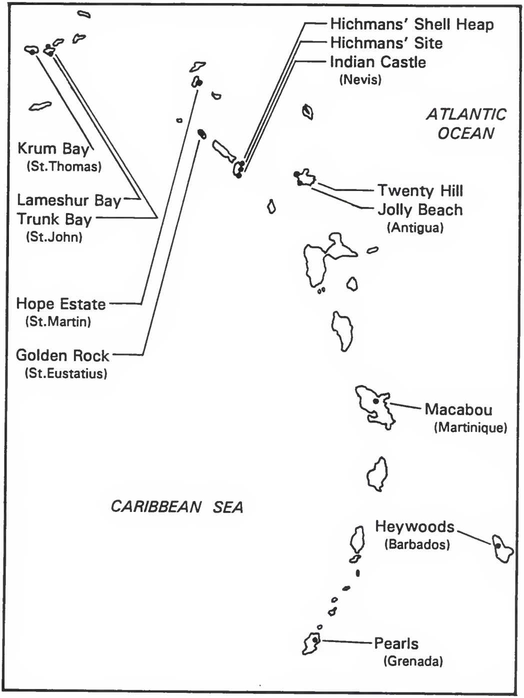


Figure 4.1. Locations of Lesser Antilles sites analyzed for plant remains.

exclusively of carbonized wood. Seeds and other non-wood remains are lacking, with the exception of a single modern seed. The lack of ancient seeds among the Wanapa materials is probably because techniques designed to recover small seeds and fragments were not employed at this site.

Of the 45 Wanapa samples analyzed, 34 yielded identifiable plant material (Table 4.1). Nine woods were identified, including at least six genera: strong bark (Bourreria sp.), boxwood (Bumelia sp.), caper tree (Capparis sp.), geelhout (Casearia sp.), buttonwood (Conocarpus erectus), and lignum-vitae (Guaiacum sp.) (Table 4.2). Two additional wood types are assigned to the families Bignoniaceae and Flacourtiaceae, but could not be otherwise identified. The wood designated cf. Capparis sp. (Table 4.2) possibly represents a separate species of caper tree, but further identification was impeded by poor preservation of the individual specimens. Finally, three additional wood types are recognized and preliminarily described by anatomy (Wanapa types 1-3; Table 4.2), but each is represented by insufficient material with which to proceed further with identification.

Plant identifications for individual proveniences from the Wanapa site are shown in Table 4.3. On a sample by sample basis, species diversity is narrow, with fewer than six wood types appearing in a given sample. Lignum-vitae is prominent among the samples from Wanapa, comprising the bulk (56%) of the identifications. Lignum-vitae is also most

Table 4.1. Archaeobotanical samples from the Wanapa Site, Bonaire.
(No clearly archaeological seeds were recovered.)

PROVENIENCE area/unit/level	--------SAMPLE-------- CONTEXT	VOLUME (ltrs.)	WEIGHT (grams	WOOD WEIGHT (grams)	WOOD DENSITY	WOOD NO. IDEN.	TOTAL SEEDS
A 116/110 lv.1	midden	200	-	0.18	<0.1	2	0
116/110 lv.2	midden	200	-	1.33	<0.1	8	0
116/110 lv.3	midden	200	-	2.24	<0.1	13	0
116/110 lv.4	midden	200	-	5.44	<0.1	21	0
116/110 lv.5	midden	200	-	0.63	<0.1	4	0
A 116/108 lv.1	midden	200	-	0	-	0	0
116/108 lv.2	midden	200	-	0.68	<0.1	1	0
116/108 lv.3	midden	200	-	1.74	<0.1	8	0
116/108 lv.4	midden	200	-	6.79	<0.1	21	0
116/108 lv.5	midden	200	-	1.89	<0.1	12	0
A 114/112 lv.1	midden	200	-	0	-	0	0
114/112 lv.2	midden	200	-	0	-	0	0
114/112 lv.3	midden	200	-	4.40	<0.1	8	0
114/112 lv.4	midden	200	-	0.92	<0.1	3	0
A 114/110 lv.1	midden	200	-	0.29	<0.1	0	0
114/110 lv.2	midden	200	-	0.45	<0.1	1	0
114/110 lv.3	midden	200	-	1.34	<0.1	5	0
114/110 lv.4	midden	200	-	5.04	<0.1	12	0
114/110 lv.5	midden	200	-	4.06	<0.1	6	0
A 112/112 lv.1	midden	200	-	0	-	0	0
112/112 lv.2	midden	200	-	0.57	<0.1	1	0
112/112 lv.3	midden	200	-	2.90	<0.1	18	0
112/112 lv.4	midden	200	-	1.40	<0.1	7	0
112/112 lv.5	midden	200	-	0	-	0	0
A 112/110 lv.1	midden	200	-	0	-	0	0
112/110 lv.2	midden	200	-	0	-	0	0
112/110 lv.3	midden	200	-	0	-	0	0
112/110 lv.4	midden	200	-	2.97	<0.1	15	0

Table 4.1--continued.

PROVENIENCE area/unit/level		SAMPLE CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams	WOOD WEIGHT (grams)	WOOD DENSITY	WOOD NO. IDEN.	TOTAL SEEDS
112/110	lv.5	midden	200	-	0.24	<0.1	1	0
B 90/124	lv.1	midden	200	-	0	-	0	1
90/124	lv.2	midden	200	-	0.83	<0.1	6	0
90/124	lv.3	midden	200	-	5.09	<0.1	25	0
90/124	lv.4	midden	200	-	3.14	<0.1	23	0
B 90/120	lv.1	midden	200	-	0	-	0	0
90/120	lv.2	midden	200	-	0.70	<0.1	2	0
90/120	lv.3	midden	200	-	0.28	<0.1	3	0
90/120	lv.4	midden	200	-	1.86	<0.1	9	0
B 88/124	lv.1	midden	200	-	0.65	<0.1	1	0
88/124	lv.2	midden	200	-	1.35	<0.1	7	0
88/124	lv.3	midden	200	-	10.39	0.1	30	0
88/124	lv.4	midden	200	-	7.27	<0.1	24	0
B 88/120	lv.1	midden	200	-	0	-	0	0
88/120	lv.2	midden	200	-	0.44	<0.1	2	0
88/120	lv.3	midden	200	-	1.20	<0.1	3	0
88/120	lv.4	midden	200	-	0.85	<0.1	10	0
TOTALS:					79.55		312	1

Table 4.2. Plant identifications from the Wanapa site, Bonaire.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Bignoniaceae, cf. *Tabebuia* (*chrysantha*)	cedar (roble amarillo)	wood
Bourreria (*succulenta*)	strong bark (roble de guayo)	wood
Bumelia (*obovata*)	boxwood (lechecillo)	wood
Capparis sp.	caper tree (palinguán)	wood
cf. *Capparis* sp.	caper tree	wood
Casearia (*tremula*)	geelhout (cafeíllo cimarrón)	wood
Conocarpus erectus	buttonwood (mangle botón)	wood
Flacourtiaceae, cf. *Xylosma* (*arnoldii*)	roseta	wood
Guaiacum sp.	lignum-vitae (guayacán)	wood
Uniden. wood-type 1	Wanapa-1, diffuse porous, vessels solitary, parenchyma diffuse to diffuse-in-agg.*	wood
Uniden. wood-type 2	Wanapa-2, diffuse porous, vessels solitary and in short radial series, parenchyma paratracheal; cf. *Cupania* sp. (guara) or *Canella* (wild cinnamon; barbasco)*	wood
Uniden. wood-type 3	Wanapa-3, diffuse porous, vessels solitary and in short radial series, parenchyma paratracheal-sparse*	wood
Modern seeds:		
Fabaceae-Mimosoideae	tamarindo, bayahonda	seed

*Wanapa unidentified wood types 1-3 are further described in Newsom 1991b. Specific names in parentheses indicate that they are the probable species based on geographic range or on anatomical characteristics.

Table 4.3. Plant identifications from Wanapa, Bonaire* (by count).

IDENTIFICATION	116/110					116/108				114/112		114/110			
	Lv.1	Lv.2	Lv.3	Lv.4	Lv.5	Lv.2	Lv.3	Lv.4	Lv.5	Lv.3	Lv.4	Lv.2	Lv.3	Lv.4	Lv.5
(POSSIBLE) EDIBLE:															
Geelhout					1			2						3	
Strong bark			1	1				2							
OTHER:															
Boxwood															
Buttonwood					1		3		2				3		4
Caper tree-1			1	4						3	1			1	
cf.Caper tree-2															
cf. Cedar	2	3		1	1				2	2	1	1	2		
Flacourtiaceae		2												4	1
Lignum-vitae		3	11	15	1	1	5	16	8	3	1			4	1
Wanapa-1															
Wanapa-2															
Wanapa-3															
Unid. hardwood								1							
MODERN:															
Legume seed															
TOTAL NO. WOOD TYPES:	1	3	3	4	4	1	2	4	3	3	3	1	2	4	3
SEED TOTAL:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Samples with no identifiable plant material are excluded here; see Table 4.1.
Values in parentheses are tentative identifications.

Table 4.3--continued.

IDENTIFICATION	----112/112----			--112/110-		-------90/124-------				----90/120-----		
	Lv.2	Lv.3	Lv.4	Lv.4	Lv.5	Lv.1	Lv.2	Lv.3	Lv.4	Lv.2	Lv.3	Lv.4
(POSSIBLE) EDIBLE:												
Geelhout									2			
Strong bark			1					(2)	1			2
OTHER:												
Boxwood		1										
Buttonwood			2	1				3	6			2
Caper Tree-1		1			1		2	5			2	1
cf. Caper tree-2												
cf. Cedar		2	1				1		2			
Flacourtiaceae								1				
Lignum-vitae	1	13	2	14			3	13	12	2	1	4
Wanapa-1			1									
Wanapa-2		1						1				
Wanapa-3												
Unid. hardwood												
MODERN:												
Legume seed						1						
TOTAL NO. WOOD TYPES:	1	5	5	2	1	0	3	6	5	2	2	4
SEED TOTAL:	0	0	0	0	0	1	0	0	0	0	0	0

Table 4.3--continued.

IDENTIFICATION	88/124				88/120			TAXON TOTAL	UBI-QUITY
	Lv.1	Lv.2	Lv.3	Lv.4	Lv.2	Lv.3	Lv.4		
(POSSIBLE) EDIBLE:									
Geelhout			1					9	15
Strong bark			1					11	24
OTHER:									
Boxwood		1						2	6
Buttonwood			1	1	1			30	39
Caper tree-1	1		7	6				36	42
cf. Caper tree-2				(3)			1	4	3
cf. Cedar		4	3	2			1	31	51
Flacourtiaceae		1						9	15
Lignum-vitae		1	17	10	1	3	8	174	84
Wanapa-1								1	3
Wanapa-2								2	6
Wanapa-3				2				2	3
Unid. hardwood								1	3
MODERN:									
Legume seed								1	3
TOTAL NO. WOOD TYPES:	1	4	6	6	2	1	3		
SEED TOTAL:	0	0	0	0	0	0	0		

frequent in terms of occurrence, having been identified in 28 (84%) of the 33 samples with identifiable wood. Bignoniaceae (probably _Tabebuia_ sp.), caper tree, buttonwood, and strong bark are well represented, with ubiquity values of 51%, 42%, 39%, and 24%, respectively. The seven remaining woods--boxwood, cf. _Capparis_, geelhout, Flacourtiaceae, and Wanapa types 1-3 (Table 4.2)--are restricted to few proviences (15% or less of the samples), and are represented by minimal material (fewer than ten fragments each).

Pearls, Grenada

Pearls, Grenada, is the first of the Ceramic Age Saladoid sites that underwent archaeobotanical analysis as part of this research. Six proveniences from Pearls were selected for intensive study, with emphasis on areas of the site that appeared to have suffered minimal damage from looters and other forms of post-depositional disturbance. Particular samples were chosen for analysis based on initial field observations confirming that burnt plant material had survived intact, and on the simultaneous presence of abundant, well preserved bone and shell.

Samples of 3-6 liters from the six proveniences were processed by means of water flotation (Table 4.4). Nylon mesh with 0.5 mm openings was used to capture light fractions, and, in addition, lined the bottom of the heavy fraction in the flotation machine. Data from volumetric-flotation samples were supplemented with identificatons of

Table 4.4. Archaeobotanical samples from Pearls, Grenada. (Seed counts may be artificially inflated by the presence of seed fragments; a minimum number of individuals [shown in parentheses] is estimated from the presence of seed hyla [seed scars]).

PROVENIENCE	CONTEXT	SAMPLE TYPE	SAMPLE VOLUME (ltrs)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCHAEO. SEEDS	SEED DEN-SITY
W.195.5 83-093 Flot. no.15	midden	float	6.00	73.46	27.30	4.55	0	26	26(4)	4.3
W.195.5 93-103 Flot. no.12	midden	float	3.50	39.57	15.92	4.55	0	31	31(3)	8.8
W.196 40-050 Flot. no.10	midden	float	6.00	8.75	(trace)	-	0	1	1	0.2
W.196 50-060 Flot. no.11	midden	float	4.50	19.78	3.41	0.76	0	18	18(2)	4.0
W.196 60-070 Flot. no.09	midden	float	3.00	16.73	1.00	0.33	0	52	52(6)	17.3
W.196 70-083 Flot. no.16	midden	float	3.50	24.79	1.15	0.33	0	14	14(2)	4.0
W.196 70-083	midden	in situ	-	-	(trace)	-	0	2	2(2)	-
W.196 83-093	midden	in situ	-	-	(trace)	-	0	1	1	-
W.196 93-103	midden	in situ	-	-	(trace)	-	0	4	4(1)	-
W.198 surf.-10	midden	in situ	-	-	-	-	-	1	0	-
W.233 surf.-10	midden	in situ	-	-	-	-	-	3	0	-
Unit C, Lv. 7	midden	screen	-	-	-	-	-	1	0	-
TOTALS:			26.50	183.08	48.78		0	154	149(22)	

plant specimens recovered in situ during excavation, and with a single specimen from the excavation screens (Table 4.4).

Archaeobotanical identifications from Pearls are exclusively of seeds and endocarp fragments. Carbonized wood is present as well, but all wood fragments are undersized and/or too friable to undergo anatomical analysis.

Five plants were identified from among the various samples from Pearls (Table 4.5). Two taxa have no direct association with the archaeological deposits. They include a nutmeg (Myristica fragrans) seed and 4 tentatively identified specimens of European chick pea (Cicer sp.). The two seed types are indisputably modern, since the five specimens obviously are fresh. But more to the point, both nutmeg and chick pea derive from Old World regions (Willis 1973:253, 771) and could not have been present on Grenada in Precolumbian times. Chick pea presently is cultivated directly on portions of the archaeological site, and nutmeg trees grow nearby. Since the chick peas occur in the uppermost levels of test units West-198 and West-233 (Table 4.6), they undoubtedly represent unsuccessful plantings (seeds that did not sprout). Unit C deposits, which yielded the single nutmeg seed, are heavily disturbed throughout.

The status of two cockspur (Celtis iguanaea) seeds from the Pearls samples is necessarily ambiguous. The seeds do not appear to have undergone carbonization, as might effect their extended preservation, but the seed coats are worn and

Table 4.5. Plant identifications from Pearls, Grenada.

TAXON	COMMON NAME	PLANT PART
Archaeololgical:		
*Celtis iguanaea**	cockspur (azufaifo)	seed
Palmae	palm family	seed
Mastichodendron foetidissimum	mastic-bully, (tortugo amarillo)	seed
Unidentified hardwood		wood
Modern seeds:		
Fabaceae, cf. *Cicer*	cf. chick pea (Old World)	seed
Myristica fragrans	nutmeg (Old World)	seed

**Celtis* seeds are mineralized.

Table 4.6. Plant identifications from Pearls, Grenada (by count).

IDENTIFI-CATION:	195.5 83-93	195.5 93-103	196 40-50	196 50-60	196 60-70	196 70-83	196 70-83	196 83-93	196 93-103	198 0-10	233 0-10
WILD EDIBLE:											
Cockspur	1	1									
Mastic-bully	21(2)	20(1)	1	14(1)	48(5)	10(1)	2(2)	1			
Palmae	4	10		4	4	4			4		
OTHER:											
Ud. hardwood	+	+	+	+	+	+	+	+	+		
MODERN SEEDS:											
cf. chick pea										1	3
Nutmeg											
SEED TOTAL:	26	31	1	18	52	14	2	1	4	1	3
ARCH. SEEDS:	26	31	1	18	52	14	2	1	4	0	0

+ = present, but not counted individually; numbers in parentheses are scar counts.

Table 4.6--continued.

IDENTIFICATION:	Unit C Lv.7	PLANT TOTAL	UBIQUITY
WILD EDIBLE:			
Cockspur		2	33
Mastic-bully		117	100
Palmae		30	83
OTHER:			
Ud. hardwood			
MODERN SEEDS:			
cf. chick pea		4	
Nutmeg	1	1	
SEED TOTAL:	1		
ARCH. SEEDS:	0		

their extended preservation, but the seed coats are worn and more or less mineralized, suggestive of older age. In lieu of direct dates by Carbon-14 of the seeds themselves, the association of cockspur with the archaeological occupation at Pearls is uncertain. Nevertheless, the particular proveniences from which the cockspur seeds were recovered suggest the seeds may indeed be contemporaneous with the prehistoric deposits. The cockspur seeds came from an area of the site that appears to be relatively intact (W. Keegan, personal communication, May 1989), and the samples themselves (Table 4.6) lack modern seeds or other modern materials, such as glass or metal. Moreover, the two samples contained abundant, well-preserved faunal remains and Cedrosan Saladoid-subseries ceramics. In addition, the cockspur-bearing samples produced carbonized plant remains (see below) that are more reliably attributable to prehistoric activity at the site by virtue of their fragmented and carbonized condition, potential economic value, and association with archaeological sites throughout the region (further discussed below). The presence of mineralized cockspur seeds at several other sites in the Lesser Antilles (described below) further justifies considering cockspur samples from Pearls as contemporaneous with the archaeological remains, at least until demonstrated otherwise.

Mastic-bully (<u>Mastichodendron</u> <u>foetidissimum</u>) is conspicuous in Pearls samples (Table 4.6). This type of

seed is identified by its distinctive sapotaceous hilar scar (Figure 4.2) and by the general morphology of the seed. Sectioned Mastichodendron seeds are nearly circular in outline, immediately distal of the seed scar, whereas the very similar seeds of another native species belonging to a related genus (Manilkara bidentata) are more angular in sectional view. From the scars alone, or small fragments of seed coat, the two genera are very difficult or impossible to distinguish one from another. Three mastic-bully specimens from Pearls are nearly whole, making discernible their general dimensions and morphology, which are compared with measurements from modern specimens of Mastichodendron and Manilkara in Table 4.7.

Burnt seed coat fragments of mastic-bully are the most abundant type of plant remain from Pearls (117 fragments; 100% presence [ubiquity] among the flotation samples). Fragment counts potentially overestimate presence, and, by inference, the relative importance of a given plant resource. To compensate for this problem, mastic-bully hilar scars were counted as one identification each to obtain a more realistic estimation of the mininum number of individuals represented in the samples (shown in Table 4.6 in parentheses beside the raw counts). The revised count for mastic-bully from Pearls is 13 seeds. This figure seems low; however, 13+ individuals still is proportionately great relative to data from the few other Caribbean sites from which plant remains have been analyzed (see below).

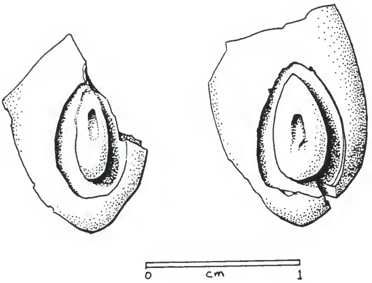


Figure 4.2. Sapotaceae seed coat fragments with
preserved hila from Pearls, Grenada.

Table 4.7. Sapotaceae seed measurements (mm). Pineland and Miami are comparative specimens from living trees. Pineland-1 are old, dry seeds that were collected from the ground in leaf litter; Pineland-2 are fresh specimens from the same tree.

SAMPLE	NUMBER MEASURED	SEED LENGTH	SEED DIAMETER	SEED* WIDTH	SEED* THICKNESS	-----HILUM----- LENGTH	WIDTH
Mastichodendron sp.:							
Pearls, W.196 60-70	1	17.50	13.37	-	-	-	7.08
Pearls, W.196 60-70	1	-	-	-	-	8.90	6.55
Pearls, W.196 60-70	1	-	-	-	-	7.63	5.50
Pearls, W.196 70-80	1	19.00	-	-	-	11.68	8.20
Mastichodendron foetidissimum:							
Pineland, Florida-1	1	11.85	10.25	-	-	5.60	4.00
Pineland, Florida-1	1	-	-	-	-	8.68	6.55
Pineland, Florida-1	1	12.95	9.55	-	-	-	-
Pineland, Florida-1	1	13.85	10.60	-	-	-	-
Pineland, Florida-2	11	15.47	11.64	-	-	4.51	3.25
Manilkara bidentata:							
Miami, Florida	6	18.06	-	12.07	9.07	5.75	3.03
Manilkara zapota:							
Miami, Florida	1	18.75	-	11.50	5.71	18.64	2.09
Miami, Florida	1	23.34	-	13.20	7.54	11.57	2.42
Miami, Florida	1	23.96	-	14.16	6.56	12.92	1.81

*Seed length and width reported for angular specimens; seed diameter is instead reported for specimens with circular cross-section.

Pineland and Miami, Florida are comparative specimens from living trees. Pineland-1 are old seeds from the leaf litter; Pineland-2 are fresh specimens from the same tree.

Thicker (than mastic) hard seed coat fragments (average thickness 2.74 mm, range 2.60-2.90 mm, n = 6) also occur in the archaeobotanical samples from Pearls. The fragments are small. Nonetheless, the surface texture and presence on several specimens of circular, ca. 1-2 mm diameter, indentations or holes identifies the fragments with the palm family (Palmae or Arecaceae; Tables 4.5, 4.6), exclusive of the genera Sabal, Cocos (e.g., coconut [C. nucifera]), and Scheelea. A characteristic of some types of palm seed, e.g. Butia spp., is the presence in the seed coat of three closely grouped openings of ca. 1-4 mm diameter. The particular type of palm represented by the seed fragments from Pearls is not certain. The fragments are too small to permit estimation of angle of curvature and thereby attempt to reconstruct the original dimensions of the seeds.

Heywoods, Barbados

Twelve proveniences from the Heywoods site underwent archaeobotanical analysis. Eight samples belong to a late Prehistoric Suazoid component of the site, and four samples are associated with an earlier Troumassoid occupation (Table 4.8). Like Wanapa, Heywoods archaeobotanical samples consist of plant materials that were captured in excavation screens, and carbonized remains are exclusively wood. The mesh size used to sieve the Heywoods samples is relatively fine (1.8mm = 1/16 inch), but small seeds and plant fragments could pass through the mesh, which may partially account for the paucity of seeds in the samples.

Table 4.8. Archaeobotanical samples from Heywoods Site, Barbados. (Wood and seed concentrations [density] are not available because the original samples volumes were not recorded prior to sieving procedures.)

PROVENIENCE	CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DENSITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS
Suazoid:									
HW/14/4	midden	-	11.94	-	11.94	-	1	0	0
HW/16/4	midden	-	0.20	-	0.20	-	1	0	0
HW/21/1	midden	-	(trace)	-	(trace)	-	2	0	0
HW/23/2	midden	-	0.59	-	0.50	-	0	0	0
HW/32/3	midden	-	0.60	-	0.60	-	3	0	0
HW/34/6	midden	-	1.83	-	(trace)	-	0	3	0
HW/35/7	midden	-	0.96	-	0.96	-	1	0	0
HW/36/2	midden	-	2.59	-	2.59	-	1	0	0
TOTALS Suazoid:			18.71		16.79		9	3	0
Troumassoid:									
HW/25/7	midden	-	0.67	-	0.67	-	1	0	0
HW/39/5	midden	-	0.48	-	0.48	-	2	0	0
HW/39/6	midden	-	0.57	-	0.57	-	0	0	0
HW/39/7	midden	-	0.40	-	0.40	-	1	0	0
TOTALS, Troumassoid:			2.12		2.12		4	0	0

Nine plant types were recovered in the samples from the Heywoods Site (Table 4.9). One wood, manchineel (Hippomane mancinella), is identified to species, another to genus (Guiana plum, Drypetes sp.), and two (Myrtaceae and Palmae) to family (palm genera are not separable by wood anatomy). Four additional wood types are classified as nearly as possible to family, or, in one case, described anatomically (Heywoods type-1). These woods are not otherwise suitable for identification because of anatomical inadequacies or insufficient surface area with which to fully document cellular detail.

No single wood from Heywoods site from either cultural component occurs in quantity (Table 4.10). This is probably a reflection of preservation biases, based on the relatively poor condition of specimens that have survived. Manchineel is the most frequent (5 specimens) and the most ubiquitous (25% presence) of the plants recovered (Table 4.10). Caustic manchineel sap reportedly was used by Caribbean Indians to coat the tips of poison arrows (Krieger 1929:491; Sturtevant 1969).

Leeward Islands

Twenty Hill (PE-19) and Jolly Beach (MA-3; MA-4), Antigua

A pair of archaeological sites on Antigua was examined for evidence of prehistoric plant use. The sites belong to the Jolly Beach culture (Rouse 1992:65-68) that pre-dates the Ceramic Period "repeopling" (Rouse 1992) of the islands by Saladoid populations. Twenty Hill and Jolly Beach are

Table 4.9. Plant identifications from Heywoods, Barbados.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
cf. Bignoniaceae, *Bignonia* sp.	vine	wood
Bombacaceae or Malvaceae, *Ceiba* or *Hibiscus* sp.	bombax or mallow family, silk-cotton or mahoe	wood
Drypetes sp.	Guiana plum (palo blanco)	wood
Hippomane mancinella	manchineel (manzanillo)	wood
cf. Meliaceae	mahogany family	wood
Myrtaceae, cf. *Eugenia* sp.	black cherry, wattle	wood
Palmae	palm family	wood
Uniden. wood-type 1	Heywoods-1, diffuse porous, vessels infreq., narrow, heterocellular rays*	wood
Modern seeds:		
Argemone mexicana	Mexican poppy (cardo santo)	seed

*Heywoods unidentified wood-type 1 is further described in Wing and Newsom 1992.

Table 4.10. Plant identifications from Heywoods Site, Barbados (by count). (All archaeological identifications are wood remains; values in parentheses are tentative identifications.)

IDENTIFICATION:	Suazoid: 14/4	16/4	21/1	23/2	32/3	34/6	35/7	36/2	Troumassoid: 25/7	39/5	39/6	39/7	PLANT TOTAL	UBI-QUITY
WILD EDIBLE:														
Palmae			1										1	8.3
OTHER:														
cf. Bignoniaceae								1		(1)			2	16.7
Bombacaceae/ Malvaceae			1										1	8.3
Guiana plum										1			1	8.3
Manchioneel	(1)				3				1				5	25.0
cf. Meliaceae		1										(1)	2	16.7
Myrtaceae							1						1	8.3
Heywoods type-1	1												1	8.3
Uniden. hardwood				1		1					1			
MODERN SEEDS:														
Mexican poppy						3							3	8.3
TOTAL NO. WOOD TYPES:	2	1	2	1	1	1	1	1	1	2	1	1		
SEED TOTAL:	0	0	0	0	0	3	0	0	0	0	0	0		
ARCHAEO. SEEDS:	0	0	0	0	0	0	0	0	0	0	0	0		

remnants of earlier, Archaic Age Ortoiroid occupations, as described in Chapter 3.

Thirteen samples were analyzed from Twenty Hill (PE-19), and three samples from Jolly Beach (MA-3; MA-4) (Table 4.11). Most of the remains were collected as volumetric samples that were dry sieved through small-sized mesh (4.0-0.42 mm) to remove soil particles. Three samples of coarser-sieved (1.8mm = 1/16") material from the excavation screens supplement the volumetric samples.

Table 4.12 lists the types of plants recovered from the Twenty Hill and Jolly Beach excavations. Wood remains survived poorly; only two fragments are adequate for anatomical characterization, neither of which came from Jolly Beach. One wood is tentatively identified as bustic (Dipholis sp.), a member of the sapota family (Sapotaceae). The second wood fragment (Twenty Hill type-1) is too poorly preserved to fully detail its anatomical structure; it possibly belongs to the bay family (Lauraceae).

A single seed--Mexican poppy (Argemone mexicana)--was recovered in the samples from Jolly Beach. The seed is carbonized, hence its inclusion among the archaeological remains listed in Table 4.12. However, in the absence of supportive evidence to the contrary, it is probable that the small (1 mm diameter) seed is modern (having possibly blown or fallen into the excavation).

Seed identifications from Twenty Hill are more numerous and diverse (Table 4.12 and 4.13). They include cockspur

Table 4.11. Archaeobotanical samples from Twenty Hill (PE-19) and Jolly Beach (MA-3), Antigua. (Most samples were fine-sieved to 0.4 mm; Unit 1 samples were passed through 1.8 mm mesh during excavation.)

PROVENIENCE	CONTEXT	SAMPLE TYPE	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCHAEO. SEEDS	SEED DEN-SITY
Twenty Hill (Ortoiroid) PE-19:										
Column, 0-05 cmbs	midden	sieve	0.30	-	-	-	-	3	0	-
Column, 5-10 cmbs	midden	sieve	1.70	-	0.68	0.40	0	7	6	3.5
Column, 10-15 cmbs	midden	sieve	1.80	-	(trace)	-	0	7	7	3.9
Column, 15-20 cmbs	midden	sieve	2.00	-	(trace)	-	0	5	5	2.5
Column, 20-25 cmbs	midden	sieve	2.80	-	0.42	0.15	0	13	13	4.6
Column, 25-30 cmbs	midden	sieve	1.80	-	(trace)	-	0	3	3	1.7
Column, 30-35 cmbs	midden	sieve	2.20	-	(trace)	-	0	17	15	6.8
Column, 35-40 cmbs	midden	sieve	2.00	-	0.40	0.20	0	26	26	13.0
Column, 40-45 cmbs	midden	sieve	2.00	-	0.41	0.20	0	41	39	19.5
Column, 45-50 cmbs	midden	sieve	2.40	-	0.42	0.17	0	29	29	12.1
Unit 1 NE, Level 2	midden	screen	-	-	(trace)	-	0	63	40	-
Unit 1 NE, Level 4	midden	screen	-	23.61	9.30	-	1	1	1	-
Unit 1 NE, Level 7	midden	screen	-	36.64	36.64	-	1	0	0	-
TOTALS TWENTY HILL:			19.00	60.25	48.27		2	215	184	
Jolly Beach (Casimir-oid/Ortoiroid):										
MA-3 Lv.VII sample	midden	sieve	0.50	-	(trace)	-	0	0	0	-
MA-3 Lv.VII sample	midden	sieve	0.15	-	(trace)	-	0	0	0	-
MA-4, sample 3	midden	sieve	0.10	-	(trace)	-	0	1	1	10.0
COMBINED SITE TOTALS:			19.75	60.25	48.27		2	216	185	

Table 4.12. Plant identifications from Twenty Hill (PE-19), and Jolly Beach (MA-3, -4), Antigua.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
_Argemone mexicana_*	Mexican poppy (cardo santo)	seed
_Celtis iguanaea_*	cockspur (azufaifo)	seed
cf. _Dipholis_ sp.	bustic (sanguinaria)	wood
Sapotaceae, cf. _Manilkara_ or _Mastichodendron_	bullet-wood (ausubo) or mastic-bully (tortugo amarillo)	seed
Zanthoxylum sp.*	satinwood (espinosa)	seed
Uniden. wood type-1	Twenty Hill-1, unilaterally paratracheal parenchyma, rays biseriate, intervessel pits small to fine	wood
Unidentified seed		seed
Modern seeds:		
Fabaceae-Mimosoideae	tamarindo, bayahonda	seed
Malvaceae, cf. _Sida_	mallow family	seed
cf. _Momordica charantia_	balsam apple (cundeamor)	seed
Passiflora sp.	passion flower (parcha)	seed
Setaria sp.	foxtail millet (arrocillo)	seed
Unidentified weed		seed

*_Celtis_ and _Zanthoxylum_ appear mineralized, but could possibly be modern, rather than archaeological, in nature. Likewise, a single _Argemone_ is carbonized, but may also be modern.

Table 4.13. Plant identifications from Twenty Hill and Jolly Beach, Antigua (by count).

IDENTIFICATION:	PE-19 COLUMN SAMPLES:										-PE-19 UNIT 1-		
	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	Lv.2	Lv.4	Lv.7
WILD EDIBLE:													
Bullet-wd./mastic				2	4		2	2	13	15			
Cockspur (Celtis)		4	7	3	9	3	13	24	26	14		1	
OTHER:													
cf. bustic (wood)												1	
Mexican poppy													
Satinwood		2									39		
Twenty Hill-1													1
Unid. hardwood		6	10	11	14	4	9	9	34	27	5		
Unid. seed											1		
Unid. soft tissue					1					1			
MODERN SEEDS:													
Balsam apple	1												
Panicoid grass											13		
Mallow family											3		
Passion flower											4		
Tamarindo	2	1											
Unid. seed							2		2		3		
TOTAL NO.													
WOOD TYPES:	0	1	1	1	1	1	1	1	1	1	1	1	1
SEED TOTAL:	3	7	7	5	13	3	17	26	41	29	63	1	0
ARCHAEO. SEEDS:	0	6	7	5	13	3	15	26	39	29	40	1	0

Table 4.13--continued.

IDENTIFICATION:	JOLLY BEACH: MA-3,VII samp.1	MA-3,VII samp.2	MA-4 samp.3	TOTALS PE-19	UBIQUITY PE-19	COMBINED SITES TOTAL
WILD EDIBLE:						
Bullet-wood/mastic				38	46	38
Cockspur (Celtis)				104	77	104
OTHER:						
cf. bustic (wood)				1	8	1
Mexican poppy			1	0		1
Satinwood				41	15	41
Twenty Hill-1				1	8	1
Unid. hardwood	4	2	1			
Unid. seed				1	8	1
Unid. soft tissue						
MODERN SEEDS:						
Balsam apple				1	8	1
Panicoid grass				13	8	13
Mallow family				3	8	3
Passion flower				4	8	4
Tamarindo				3	15	3
Unid. seed				7		7
TOTAL NO. WOOD TYPES:	1	1	1			
SEED TOTAL:	0	0	1			
ARCHAEO. SEEDS:	0	0	1			

(Celtis iguanaea, also recovered from the deposits at Pearls), sapota family (Sapotaceae), satinwood/wild lime (Zanthoxylum sp.), and at least six types of unquestionably modern seed. Cockspur seed coat fragments and a few whole specimens are ubiquitous, appearing in nearly every level from Twenty Hill (Table 4.13). All cockspur specimens from Twenty Hill are mineralized, just as are those from Pearls. It is very difficult to distinguish very small seed-coat fragments of cockspur from two other, unrelated genera that have similar seeds: nance or guana berry (Byrsonima spp.) and inkberry (Scaevola plumieri); these might also be represented among the seed coat fragments from Twenty Hill, but for the present all specimens are grouped as cockspur.

Unlike the specimens recovered from the Pearls site, Sapotaceae seed coat fragments from Twenty Hill lack hilar scars. However, surface texture, shape, and thickness indicate that the Twenty Hill seed coats are similar, or identical, to the mastic-bully specimens described above from Pearls. Unfortunately, identification to genus is precluded by the small size of the seed coat fragments from Twenty Hill. Thus the Sapotaceae seed coat fragments are designated Manilkara/Mastichodendron in Tables 4.12 and 4.13 to reflect that either or both genera are possibly represented in the archaeological contexts.

Fourteen percent of the seed identifications from Twenty Hill are modern specimens (31 total). The bulk of these seeds (77%) derive from a single excavation level

(Level 2, 5-10 cm below surface). The proportion of modern seeds rises to 82% of the total assemblage if mineralized and otherwise questionably ancient specimens (marked by an asterisk in Table 4.12) are grouped as modern, rather than archaeological seeds. So conspicuous a presence of modern, intrusive seeds renders all identifications from Twenty Hill suspect, in particular, those from Level 2. With this caveat in mind, apparently mineralized satinwood (Zanthoxylum sp.) seeds may be best regarded as modern or relatively recent, since they occur exclusively in Level 2 of the Twenty Hill excavations. Bullet-wood/mastic and cockspur seeds are more securely associated with the archaeological components of Twenty Hill since the specimens are concentrated in more deeply buried portions of the site (Table 4.13), in which were discerned no indication of post-depositional disturbance. Furthermore bullet-wood/mastic and cockspur are well represented among the samples from Twenty Hill and occur relatively consistently (77% and 46% ubiquity; Table 4.13).

Hichmans' Shell Heap (GE-6), Nevis

Hichmans' Shell Heap (GE-6) on the island of Nevis is a relatively small, Ortoiroid-aged refuse deposit. Ten 20-liter flotation samples from Hichmans' Shell Heap were analyzed for archaeobotanical information, including one off-site sample (no. 10, Table 4.14) designed to assist interpretion and control for the possible presence of modern seeds among the archaeological samples. In addition,

Table 4.14. Archaeobotanical samples from Hichmans' Shell Heap (GE-6), Nevis. (All but samples from general excavation levels were processed by water flotation; specimens from the general excavations were collected with 1.5 mm mesh screens.)

PROVENIENCE	SAMPLE CONTEXT	SAMPLE VOLUME (ltrs)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	SEED DEN-SITY
GE-6 Flot. 1	midden	20.00	1000.00	30.28	(trace)	-	0	130	3	0.15
GE-6 Flot. 2	midden	20.00	958.00	7.24	(trace)	-	0	41	0	-
GE-6 Flot. 3	midden	20.00	508.00	7.25	0.21	0.01	0	19	4	0.20
GE-6 Flot. 4	midden	20.00	254.00	3.72	(trace)	-	0	58	2	0.10
GE-6 Flot. 5	midden	20.00	380.00	9.12	(trace)	-	0	68	0	-
GE-6 Flot. 6	midden	20.00	788.00	7.77	(trace)	-	0	21	0	-
GE-6 Flot. 7	midden	20.00	704.00	3.41	(trace)	-	0	4	1	0.05
GE-6 Flot. 8	midden	20.00	877.00	6.16	0.20	0.01	0	20	0	-
GE-6 Flot. 9	midden	20.00	360.00	8.15	(trace)	-	0	50	1	0.05
GE-6 Flot. 10	control	20.00	562.00	56.38	0.00	-	0	43	0	
Square 5, -1, 0-10cm	midden	-	-	-	(trace)	-	0	1	0	-
TOTALS GE-6:		200.00	6391.00	139.48	0.41		0	455	11	

preserved material from one, 1.5 mm-screened excavation-unit level also underwent examination in conjuction with faunal analysis carried out at the Florida Museum of Natural History.

Wood remains are few (Table 4.14) and not generally identifiable. Two seed types are likely associated with the prehistoric deposits (Table 4.15); they are evening primrose (Oenothera sp.) and Sapotaceae seed coat. The latter is same as was recovered from Pearls and from Twenty Hill.

Modern seeds are particularly frequent among the midden samples, with 455 individuals identified (Tables 4.14 and 4.16). Most of these seeds belong to a single genus, purslane (Portulaca sp.) (363 seeds total; Table 4.16). Purslane is very common in open, disturbed-ground environments of the Caribbean; the seeds are very small (approximately 0.5-1.0 mm) and readily disperse into archaeological deposits while excavation units are open (see, for example, Miksicek 1987). The same is true of virtually all of the other seed types from Hichmans' Shell Heap (Table 4.15 and 4.16), most of which are less than 2 mm in diameter.

The single Oenothera seed (1.72 mm long by 0.60 mm wide) and the small Sapotaceae seed coats might also be modern; they could have been carbonized with recent ground cover, rather than by prehistoric activities (Miksicek 1987). Nevertheless, these two seed types do not appear in the control sample (Table 4.16), while at least four of the

Table 4.15. Plant identifications from Hichmans' shell heap (GE-6), Nevis.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Oenothera sp.	evening primrose	seed
Sapotaceae, cf. Manilkara or Mastichodendron	bullet-wood (ausubo) or mastic-bully (tortugo amarillo)	seed
Unidentified seed	fragmentary	seed
Modern seeds:		
cf. Aizoaceae		seed
Asteraceae	sunflower family	seed
Caryophyllaceae	chick weed family	seed
Fabaceae	legume family	seed
Fabaceae-Mimosoideae	tamarindo, bayahonda	seed
Malvaceae, cf. Sida	mallow family	seed
Poaceae	grass family	seed
Portulaca sp.	purslane (verdolaga)	seed
cf. Rosaceae	cherry family	pit

Table 4.16. Plant identifications from Hichmans' Shell Heap (GE-6), Nevis (by count).

IDENTIFICATION:	Flotation Samples: no.1	no.2	no.3	no.4	no.5	no.6	no.7	no.8	no.9	Con-trol, no.10	Sq.5, -1, 0-10	TOTALS GE-6	UBI-QUITY
CULTIVATED:													
Primrose*				1								1	10
WILD EDIBLE:													
Bullet-wd./mastic	3			(1)								4	20
OTHER:													
Unid. seed			4				1		1			6	
MODERN SEEDS:													
Aizoaceae	1					1						2	20
Caryophyllaceae	4	1		1	5	5			10			26	60
Cherry family								1		1	1	3	30
Fabaceae-Mimos.					1							1	10
Fabaceae	1											1	10
Grass family										2		2	20
Mallow family				1								1	10
Purslane	111	40	15	43	57	10	3	9	39	36		363	100
Sunflower family	10			10	5	5		10		1		41	60
Unid. seed/fruit										3		3	
TOTAL NO. WOOD TYPES:	0	0	0	0	0	0	0	0	0	0	0		
SEED TOTAL:	130	41	19	57	68	21	4	20	49	43	1		
ARCHAEOLOGICAL SEED TOTAL:	3	0	4	2	0	0	1	0	0	0	0		

*Primrose is listed as a cultivated plant because of its possible role as a tended, housegarden species (see text).

undisputedly modern (not carbonized, fresh) seed types, particularly purslane, do. For the present, Oenothera seeds and Sapotaceae seed coats are classified as archaeological because of clearer associations of both plants with archaeological contexts at other sites, including Pearls and Twenty Hill (and see below), and, secondly, because Oenothera sp. no longer occurs in the Lesser Antilles (Richard Howard, New York Botanical Garden, personal communication, October 1990; Warren Wagner, Smithsonian Institution, personal communication, 23 May 1991). Oenothera's prehistoric presence in the Caribbean Islands may directly result from human activity. Hichman's Shell Heap provides the earliest record for Oenothera in the Caribbean region; other archaeological sites described below document a broader geographic distribution. The economic potential and apparently once expanded range of Oenothera are further discussed below.

Hichmans' Site (GE-5) and Indian Castle (GE-1), Nevis

Two Ceramic Age sites were examined for further evidence of prehistoric plant use on Nevis. Hickmans' Site (GE-5) is near Hichmans' Shell Heap, but is attributed to a later, Saladoid occupation (Wilson n.d.). Still later aged Indian Castle (GE-1), an Elenan Ostionoid site, is also close to the Hichmans sites, but lies further south along Nevis's southeastern coast (Wilson n.d.). A pair of samples from Hichmans' Site and six samples from Indian Castle were analyzed; half are flotation samples of either two or ten

liters, and half are samples from the general excavation levels (Table 4.17).

Wood remains from Hichmans' Site and Indian Castle are somewhat better preserved than are those from Hichmans' Shell Heap (GE-6). This resulted in the identification or description of ten wood specimens and five types (Tables 4.17 and 4.18). Five fragments of lignum-vitae (Guaiacum sp.) were identified; the same wood is present in 84% percent of the proveniences analyzed from the Wanapa Site on Bonaire. The four other types of wood, one from Hichmans' Site (strong bark, Bourreria sp.), and three from Indian Castle (Indian Castle woods 1-3) occur as single identifications each (Table 4.19). Indian Castle type-1 is similar to a wood (fish poison, Piscida carthagenesis) from the Golden Rock Site on St. Eustatius (described below); Indian Castle-2 may be black mangrove (Avicennia germinans); and Indian Castle-3 may be a member of the spurge family (Euphorbiaceae). The three provisionally described woods from Indian Castle are not suitable for more definitive identification in the absence of additional archaeological specimens of the same types.

One cockspur (Celtis iguanaea) seed was recovered in the Indian Castle samples. While the seed is apparently mineralized, like those from Pearls, Twenty Hill, and Hickmans' Shell Heap, its presence in surface deposit (0-10 cm below surface) at Indian Castle suggests cockspur may be modern. Likweise, no certain archaeological seeds were

Table 4.17. Archaeobotanical samples from Hichmans' Site (GE-5) and Indian Castle (GE-1), (All but samples from general excavation levels were processed by water flotation; specimens from the general excavations were collected with 1.5 mm mesh screens.)

SITE/ PROVENIENCE	SAMPLE CONTEXT	SAMPLE VOLUME (ltrs)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN- SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCHAEO. SEEDS	SEED DEN- SITY
Saladoid:										
GE-5 Flot. 1, (Lab. no. 15)	midden	10.00	-	84.96	0.40	0.04	1	61	(1)	0.10
Square 55, -15, 30-40 cm	midden	-	-	-	(trace)	-	1	0	0	-
Ostionoid:										
GE-1 Flot. 1	refuse pit	2.00	465.00	1.33	0.33	0.16	2	0	0	-
GE-1 Flot. 2	post mold	2.00	605.00	2.30	0.39	0.19	1	0	0	-
GE-1 Flot. 3	post mold	2.00	965.00	3.76	0.43	0.21	1	0	0	-
Square 3A-N, 0-10 cm	midden	-	-	-	(trace)	-	1	1	1	-
Square 3B-N, 0-10 cm	midden	-	-	-	(trace)	-	2	0	0	-
Square 3B-N, 10-20 cm	midden	-	-	-	(trace)	-	1	0	0	-
COMBINED SITE TOTALS:		16.00	2035.00	92.35	1.55		10	62	1(2)	

Table 4.18. Plant identifications from Hichmans' site (GE-5), and Indian Castle (GE-1), Nevis.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
cf. Bourreria sp.	strong bark (roble de guayo)	wood
Celtis iguanaea*	cockspur (azufaifo)	seed
Guaiacum sp.	lignum vitae (guayacán)	wood
Hippomane mancinella*	manchineel (manzanillo)	seed
Uniden. wood type-1	Indian Castle-1, confluent parenchyma = 1/2 ground mass	wood
Uniden. wood type-2	Indian Castle-2, pores in long radial series (chains), possibly Avicennia (black mangrove)	wood
Uniden. wood type-3	Indian Castle-3, pores solitary, axial parenchyma abundant, diffuse-in-aggregates	wood
Unidentified hardwood		
Modern seeds:		
Caryophyllaceae	chick weed family	seed
Euphorbiaceae	spurge family	seed
Euphorbia nutans	nodding spurge	seed
Fabaceae cf.Desmodium	trefoil (zarzabacoa)	fruit
Malvaceae, cf. Sida	mallow family	seed
Poaceae	grass family	seed
Portulaca sp.	purslane (verdolaga)	seed

*Celtis is mineralized; manchineel fragments appear somewhat mineralized, but may be modern.

Table 4.19. Plant identifications from Hichmans' Site (GE-5) and Indian Castle (GE-1) (by count).

IDENTIFICATION:	GE-5: no.1	Sq.55 -15	GE-1: no.1	no.2	no.3	3A-N 0-10	3B-N 0-10	3B-N 10-20	COMBINED TOTAL
WILD EDIBLE:									
Cockspur						1			1
OTHER:									
Lignum-vitae		1			1		2	1	5
Manchioneel	1								1
cf. Strong bark	1								1
Indian Castle-1			1						1
Indian Castle-2			1						1
Indian Castle-3						1			1
Unid. hardwood				1					1
MODERN SEEDS:									
Caryophyllaceae	7								7
Fabaceae, Desmodium	1								1
Grass family	15								15
Mallow family	1								1
Nodding spurge	1								1
Purslane	33								33
Spurge family	1								1
TOTAL WOOD TYPES:	1	1	2	1	1	1	1	1	
SEED TOTAL:	61	0	0	0	0	1	0	0	
ARCHAEOLOGICAL SEED TOTAL:	(1)	0	0	0	0	1	0	0	

identified in the samples from Hichmans' Site. The flotation sample (No. 1, Table 4-19) contains abundant modern seeds in essentially the same types and frequencies as were documented above in the samples from Hichman's Shell Heap.

Golden Rock, St. Eustatius

Fifty samples, comprised of two types, from Cedrosan-Saladoid Golden Rock were examined (Table 4.20). Thirty were volumetric samples (1 to 10 liters) that were dry sieved through fine-meshed screens (to 0.5 mm); the rest consisted of carbonized wood remains that were collected as they were observed *in situ* during excavation. The former derive from general shell-midden (household refuse) deposit, including hearths and pit-like features associated with the midden. The latter samples are primarily fill from post holes, including in some cases the contents of post pipes (not post-construction pits), whenever it was possible to discern the post outline, as for example from a post that rotted or burnt in its standing position (Newsom 1992c; Schinkel 1992).

In an effort to maximize data capture under the constraints of limited time and funding, wood analysis of Golden Rock proveniences emphasized house-structural details (posts). However, carbonized wood from six midden samples also were analyzed. Two midden samples are believed to represent *in situ* hearths; three other midden samples represent secondarily deposited household refuse, including

Table 4.20. Overview of archaeobotanical samples from Golden Rock, St. Eustatius. (Seed counts marked by [X] are from Van der Klift's [1985] analysis of midden samples in which seeds were reported on a presence/absence basis only.)

PROVENIENCE	SAMPLE CONTEXT*	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCHAEO. SEEDS	SEED DEN-SITY
WOOD ANALYSES:									
Structure 1, F.1022	fill	-	(trace)	(trace)	-	1	0	0	-
Structure 1, F.1084-1	fill	-	(trace)	(trace)	-	1	0	0	-
Structure 1, F.1084-2	fill	-	(trace)	(trace)	-	13	0	0	-
Structure 1, F.1084-3	fill	-	(trace)	(trace)	-	20	0	0	-
Structure 1, F.1081-1	pit	-	(trace)	(trace)	-	20	0	0	-
Structure 1, F.1081-2	pit	-	(trace)	(trace)	-	1	0	0	-
Structure 4, F. 135-1	pipe	-	(trace)	(trace)	-	5	0	0	-
Structure 4, F. 135-2	pipe	-	(trace)	(trace)	-	1	0	0	-
Structure 4, F. 135-3	pipe	-	(trace)	(trace)	-	20	0	0	-
Structure 4, F. 135-4	pipe	-	(trace)	(trace)	-	20	0	0	-
Structure 4, F. 186	pipe	-	84.00	83.65	-	10	0	0	-
Structure 4, F. 191	pipe	-	46.00	45.80	-	17	0	0	-
Structure 4, F. 210	pipe	-	171.00	171.00	-	1	0	0	-
Structure 4, F.1200-1	pipe	-	145.00	146.40	-	30	0	0	-
Structure 4, F.1200-2	pipe	-	291.00	291.00	-	30	0	0	-
Structure 5, F.1703	pipe	-	(trace)	(trace)	-	10	0	0	-
Structure 5, F.1704	pipe	-	(trace)	(trace)	-	10	0	0	-
Structure 5, F.1707	pipe	-	(trace)	(trace)	-	1	0	0	-
Structure 5, F.1711	pipe	-	(trace)	(trace)	-	10	0	0	-
Structure 5, F.1997	pipe	-	(trace)	(trace)	-	5	0	0	-
Midden, 18-I-VI	refuse	10	-	15.60	1.6	7	0	0	-
Midden, 19-P-III	refuse	10	-	42.57	4.3	10	0	0	-
Midden, 19-P-IV	refuse	10	-	21.60	2.2	6	0	0	-
Midden, 20-F-III	hearth	1-6	-	(trace)	-	1	0	0	-
Midden, 20-H-IV	hearth	1-6	-	11.20	1.9	10	0	0	-
Midden, 21-H-VII	pit	1-6	-	43.00	7.2	20	0	0	-

Table 4.20--continued.

PROVENIENCE	SAMPLE CONTEXT*	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCHAEO. SEEDS	SEED DEN-SITY
SEED ANALYSES:									
Midden, 3-O-II	refuse	10	-	-	-	-	3	3	0.3
MIdden, 3-P-IV	refuse	10	-	-	-	-	11	11	1.1
Midden, 4-H-III	refuse	10	-	-	-	-	20	20	2.0
Midden, 4-I-III	refuse	10	-	-	-	-	3	3	0.3
Midden, 4-K-III	refuse	10	-	-	-	-	5	5	0.5
Midden, 4-M-IV	refuse	10	-	-	-	-	42	41	4.1
Midden, 4-N-III	refuse	10	-	1.49	-	-	12	12	1.2
Midden, 4-P-III	refuse	10	-	-	-	-	18	17	1.7
Midden, 4-P-IV	refuse	10	-	-	-	-	0	0	-
Midden, 5-I/J-III	refuse	1-6	-	-	-	-	X	X	-
Midden, 5-B-IV	refuse	1-6	-	-	-	-	X	X	-
Midden, 7-O-II/III	refuse	10	-	-	-	-	2	2	0.2
Midden, 7-I-III	refuse	10	-	-	-	-	3	3	0.3
Midden, 7-P-III	refuse	10	-	-	-	-	X	X	-
Midden, 7-F-VI	refuse	1-6	-	-	-	-	X	X	-
Midden, 7-P-VI	refuse	10	-	-	-	-	X	X	-
Midden, 9-P-II	refuse	10	-	-	-	-	X	X	-
Midden, 9-P-III	refuse	10	-	-	-	-	X	X	-
Midden, 9-P-III	refuse	10	-	-	-	-	2	2	0.1
Midden, 9-P-IV	refuse	10	-	-	-	-	X	X	-
Midden, 15-P-III	refuse	10	-	-	-	-	X	X	-
Midden, 15-P-IV	refuse	10	-	-	-	-	X	X	-
Midden, 19-P-III	refuse	10	-	(above)	(above)	(above)	X	X	-
Midden, 19-P-IV	refuse	10	-	(above)	(above)	(above)	X	X	-
TOTALS:			737.00	873.31		280	120	118	

*fill = wood from post-hole fill; pipe = wood collected from within the confines of a postpipe; refuse = secondarily deposited materials; hearth, pit = primary or otherwise not clearly redeposited hearth or refuse deposit. Sample weights not available.

charcoal. Midden samples, therefore, should provide information about fuelwood selection. Aside from limited wood identification, midden sample analysis focused on the collection of potential dietary information: midden samples were analyzed specifically for seeds and other non-woody plant tissues, and wood remains, other than those mentioned above, were set aside for a later phase of research. Twelve midden samples, including two analyzed by me for wood identification, were studied previously by Heleen Van Der Klift (1985; and see end notes for Table 4.20). These are briefly mentioned and partially included in the present analysis.

Fourteen plant types are identified from among the Golden Rock samples, including ten different woods, three types of presumably ancient seeds, and two modern seeds (Table 4.21). Provisionally archaeological seeds (cockspur [*Celtis iguanaea*] and Unidentified Types 1 and 2) from Golden Rock are classified as such because of their ambiguous status between certainly archaeological and possibly modern, consistent with the classifications of similarly mineralized seeds described above from other sites. Seeds of the three types are worn and apparently mineralized, with no hint of carbonization. Hence, the intermediate status.

Golden Rock is the fourth site described thus far (including Pearls, Twenty Hill, and Indian Castle), for which is verified the presence of cockspur. Cockspur is

Table 4.21. Plant identifications from Golden Rock, St. Eustatius.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
cf. Celastraceae, *Maytenus* or *Rhacoma*	spindle tree family, bois flament or wild cherry	wood
Celtis iguanaea	cockspur (azufaifo)	seed
cf. *Croton* sp.	pepper bush (lechecillo)	wood
Guaiacum sp.	lignum-vitae (guayacán)	wood
Piscidia carthagenensis	(= *P. piscipula*), fish poison, (ventura)	wood
Rubiaceae, cf. *Erithalis fruticosa*	black torch (jayabico)	wood
Rubiaceae	madder family	wood
Sapotaceae, cf. *Dipholis* sp.	bustic (sanguinaria)	wood
cf. *Suriana maritima*	bay cedar (guitarán)	wood
Zanthoxylum sp. type 1	satinwood (aceitillo)	wood
Zanthoxylum sp. type 2	wild lime (espinosa)	wood
Unidentified-type 1	elongate, achene-like	seed*
Unidentified-type 2	spherical	seed*
Modern seeds:		
Fabaceae	legume family	seed

*seeds not carbonized, but appear worn and mineralized; *Celtis* seeds also are mineralized.

conspicuous in Golden Rock material, appearing in 22 (73%) of the 30 midden samples studied. Cockspur is the only type of seed identified in the work by Van Der Klift (1985). As with Twenty Hill, cockspur is the most frequent seed type from Golden Rock (at least 114 individuals; Table 4.22).

The other two possibly archaeological seed types from Golden Rock (Table 4.21) have not yet been identified. The second --Unidentified-type 2-- may be an insect gall, incidental to the prehistoric occupation of the site.

Golden Rock wood remains

Ten woods were recovered in the Golden Rock samples, four of which are identified to genus or species: lignum-vitae (Guaiacum sp.), fish poison a/k/a Jamaica dogwood (Piscida carthagenesis), and two types of satinwood/wild lime (Zanthoxylum spp.). The two forms of Zanthoxylum are distinctive by wood anatomy. Nevertheless, rather than being representative of interspecific variation, the anatomical differences between the two wood types could have been ecologically and/or functionally induced (Newsom 1992c). The second form of Zanthoxylum exhibits weaker development of pore groups and paratracheal parenchyma; it also possesses slightly wider rays, on average. For the purposes of this analysis, the two types of Zanthoxylum sp. are regarded as separate woods: one that compares exceptionally well with a species commonly known as satinwood (Z. flavum), and another whose anatomy closely

Table 4.22. Plant identifications from Golden Rock deposits (by count). (Values in parentheses are tentative identifications; x = van der Klift's identifications.)

IDENTIFICATION:	---STRUCTURE 1---			--STRUCURE 4 POSTS--					---STRUCTURE 5 POSTS---					MIDDEN:		
	1022 posth.	1081 pit	1084 posth.	135	186	191	210	1200	1703	1704	1707	1711	1997	30-II	3P-IV	4H-III
WILD EDIBLE:																
Cockspur (Celtis)*														2	11	20
OTHER:																
Bay cedar													5			
Black torch						2	1	60								
Bustic					10					10						
Celastraceae																
Fish poison		1														
Lignum-vitae	1	20	1						10							
Pepper bush																
Rubiaceae																
Satinwood			33	46		15						8				
Wild lime											1	2				
Seed type 1														1		
Seed type 2																
MODERN SEEDS:																
Legume family																
TOTAL NO. WOOD TYPES:	1	2	2	1	1	2	1	1	1	1	1	2	1			
SEED TOTAL:														3	11	20
ARCHAEO. SEEDS:														3	11	20

*Celtis seeds were recovered in 9 additional samples analyzed by Van der Klift, (see Table 4.20).

Table 4.22--continued.

IDENTIFI-CATION:	MIDDEN SAMPLES continued 4i-III	4K-III	4M-IV	4N-III	4P-III	4P-IV	70II/III	7i-III	9P-III	18i-VI	19P-III	19P-IV	-HEARTHS- 20F-III	20H-IV	PIT 21H-VII	PLANT TOTAL	UBIQUITY
WILD EDIBLE:																	
Cockspur (Celtis)*	3	5	40	12	16			3	2		x	x				114*	67*
OTHER:																	
Bay cedar																5	5
Black torch														10		73	21
Bustic																20	10
Celastraceae											1					1	5
Fish poison															20	21	10
Lignum-vitae										7	2	1				42	37
Pepper bush											1	(3)				4	10
Rubiaceae											6	2				8	10
Satinwood																102	21
Wild lime																3	10
Seed type 1					1		2									4	17
Seed type 2			1													1	5
MODERN SEEDS:																	
Legume fam.			1		1											2	11
TOTAL NO. WOOD TYPES:										1	4	3	(1)	1	1		
SEED TOTAL:	3	5	42	12	18	0	2	3	2								
ARCH. SEEDS:	3	5	41	12	17	0	2	3	2								

approximates the more localized wild lime (Z. martinicensis).

Two additional Golden Rock woods are tentatively identified at least to genus: pepper bush (Croton sp.) and bay cedar (Suriana maritima) (Table 4.21). Four more woods are identified or provisionally identified to family, including two woods in the madder family (Rubiaceae), one of which possibly is black torch (Erithalis fruticosa), one wood in the sapota family (Sapotaceae), probably bustic (Dipholis sp.), and one wood that may be a member of the spindle-tree family (Celastraceae).

Lignum-vitae is most ubiquitous of the Golden Rock woods, just as it was at Wanapa, Bonaire, Hichmans' site (GE-5), and Indian Castle, Nevis. It occurred in 37% of the samples with identifiable remains (Table 4.22). Following lignum-vitae in terms of frequency of representation, are (cf.) black torch and the satinwood-like form of Zanthoxylum sp. (both 21% ubiquity); next is the wild lime-like Zanthoxylum sp. (17% ubiquity). The balance of the Golden Rock woods have ubiquity values of 10% or less (Table 4.22).

Investigations at the Golden Rock site, conducted by Aad Versteeg and Kees Schinkel of the Instutuut voor Prehistorie, University of Leiden (Schinkel 1992; Versteeg 1990), included exhaustive measures to isolate and define the specific contexts from which specimens were recovered. This work has culminated in insights about the form and nature of the site that are particularly useful to this

thesis. The researchers' careful definition and excavation of structural (i.e. buildings) and depositional contexts, including hearths, pit-like features, and postholes at Golden Rock greatly facilitates functional interpretations of the carbonized wood remains.

Three Golden Rock woods are associated with postholes that appear to form circular house-structure outlines, and almost certainly served as post supports for the Saladoid buildings (Structures 1, 4, and 5). These woods are satinwood (two posts from Structure 4; perhaps two others, one from Structure 5, and the other from Structure 1), cf. black torch (two probable posts, Structure 4), and cf. bustic (one post each from Structure 4 and from Structure 5). Besides the apparent positioning of these woods in the circular arrangements of postpipes, additional corroborative evidence for the post/structural function of satinwood, black torch, and bustic comes from intrasample matching patterns of growth rings (general agreement of ring widths and spacing). Growth ring agreement is a strong indication that the fragments likely derive from a single, original bole or section of wood (Newsom 1992c). Moreover, post samples are characterized by very narrow species diversity (no more than two, but typically a single type of wood) (see Table 4.22, post samples; and see Newsom 1992c for additional detail). Together these data indicate that the wood specimens are in primary position, not secondarily

deposited, and probably are the remnants of the original posts.

Bay cedar and lignum-vitae were recovered from single postholes (samples 1997 and 1703, respectively) belonging to the outermost circle of posts from Structure 5. These two woods may also have served as house supports or for other parts of the structures (e.g., rafters, wattle, windbreaks) (Newsom 1992c). Corresponding growth-ring widths and curvature among on the 10 fragments of lignum-vitae from Structure 5 demonstrate that the fragments almost certainly originated as a single larger piece of wood.

Lignum-vitae appears in other contexts as well. Lignum-vitae was recovered from general midden deposit (three samples), and from within a large pit-like feature (Sample 1081) within Structure 1 (Table 4.22). Two additional lignum-vitae fragments found in samples 1022 and 1084 (Table 4.22) of Structure 1 appear to have strayed from the pit-feature sample 1081 (based on growth-ring evidence). Lignum-vitae's role at Golden Rock may have extended to fuel use, based on the wood's association with the large pit and as part of general refuse. Spent charcoal may have been redeposited on the midden with other refuse from the Saladoid houses.

Additional possible fuelwoods from Golden Rock are the Celastraceae, fish poison, pepper bush, and both Rubiaceae. These woods are distributed among hearth-like and general midden samples (Table 4.22). They may represent secondarily

deposited household sweepings, if not material burned in situ. Note, however, that hearth sample 20H-IV is near house-Structure 4, post 1200; both the post and the hearth deposit contain exclusively black torch wood. The wood in the hearth fill conceivably may have been displaced from the postmold. Thus, the black torch was not necessarily used as fuel.

The single unidentified wood specimen from the 20F-III hearth (Table 4.22) represents underdeveloped growth, based on the presence of pith, relatively acute curvature of the growth rings, and the presence of less than 4 years' growth (3 rings total). Together, these characteristics are suggestive of younger, smaller-diametered material, perhaps from a shrub or more terminal member of a tree. Smaller, more manageable "cuts" of wood are often associated with fuelwood extraction (Eckholm et al. 1984). Pepper bush, the spindle-tree woods (Table 4.21), and some Rubiaceae--all listed above as possibly having been used as fuel--conform to general fuelwood specifications, by their profusely branching habit and primary growth form of shrubs and small trees (Eckholm et al. 1984; Record and Hess 1943:122-123, 156, 457).

One final point about the Golden Rock woods concerns the presence of fish poison (Piscidia carthagenesis) in pit 21H-VII and in the large feature (sample 1081) located within Structure 1. Sample 21H-VII is from a large pit in the midden area that underlies a human burial. The wood is

not necessarily associated with the skeletal material, since the burial appears to intrude into the pit. The wood fragments from the pit were tentatively matched as from one original piece by shared longitudinal tissue distortion, such as occurs at a fork or knot, or in roey-grained wood (Core et al. 1979:22-23). Remarkably, the fish poison specimen from the Structure 1 pit exhibits the same type of structural-anatomical distortion and could have come from the same tree or section of stem/branch; if the Structure 1 specimen was mixed among the fish poison fragments from 21H-VII, it would be nearly impossible to distinguish which was which. Also noteworthy, this second occurrence of fish poison likewise is roughly associated with human skeletal material (one fragment of cranium) (Schinkel 1992). Perhaps originally, both individuals (they are separate individuals [Maat and Smits 1992]) were interred in the large pit of structure 1. Subsequently, the skeletal material, as well as carbonized fragments of fish poison, were exhumed and reburied in the midden, leaving behind the isolated fragments of bone and fish poison wood in Structure 1. The fish poison tree has been used as a sedative and for medicinal purposes (Ayensu 1981:144), as well as a fish stupifier (Record and Hess 1943:308). It is reasonable to assume that there may have been a direct assocation between the burials at Golden Rock and the presence of fish poison wood, particularly if the tree was ritually significant to the site's inhabitants.

Hope Estate (SM-026), St. Martin

Archaeobotanical samples from Hope Estate are attributed to another, but earlier (Cedrosan), Saladoid settlement (Haviser 1988). Currently, only two Hope Estate samples have been completely analyzed (Table 4.23). Even so, significant data were produced. The samples come from one-meter-square units that were excavated by 10-cm levels and with regard to the natural and cultural stratigraphy. All material from each excavation level was sieved through 2.8 mm mesh, the same procedure as was employed for the Wanapa Site. Sample XVII-Area 3-Level 6 was taken from intact midden; Sample XXII-T10-Level 3a came from an area of redeposited (secondary) midden (Jay Haviser, pers. com.).

Eight types of plants were identified from the Hope Estate samples to various taxonomic levels (Table 4.24). Strong bark (Bourreria sp.), lignum-vitae (Guaiacum sp.), and satinwood (Zanthoxylum sp.) were positively identified. Each of these three woods was recorded for at least one of the archaeological sites mentioned previously: strong bark at Wanapa, and possibly also Hichmans' Site (GE-5); lignum-vitae at Wanapa, Hichmans' Site, Indian Castle, and Golden Rock, and; satinwood at Golden Rock. Fish poison (Piscida carthagenesis) was identified in two samples from Golden Rock and is provisionally identified in the Hope Estate material.

A wood that resembles gray nickers (Caesalpinia sp.) occurs in one Hope Estate sample. A relatively low-density

Table 4.23. Archaeobotanical samples from Hope Estate (SM-026), St. Martin.

PROVENIENCE	CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DENSITY	WOOD NO. IDEN.	TOTAL SEEDS
XVII, A3, Lev. 6 (primary midden, NE)	midden	100	96.03	-	79.98	0.80	30	0
XXII, T20, Lev. 3a (secondary midden, SE)	midden	100	5.66	-	4.39	0.04	10	0
TOTALS:		200	101.69	-	84.37		40	0

Table 4.24. Plant identifications from Hope Estate (SM-026), St. Martin.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Bourreria sp.	strong bark (roble de guayo)	wood
cf. *Caesalpinia* sp.	gray nickers (mato azul)	wood
Guaiacum sp.	lignum-vitae (guayacán)	wood
cf. *Piscidia carthagenensis*	(= *P. piscipula*) fish poison (ventura)	wood
Zanthoxylum sp.	satinwood (aceitillo)	wood
Uniden. wood-type 9	Hope Estate-9, cf. *Ceiba pentandra* (kapok), density <0.5, vessels infrequent	wood
Unidentified hardwood		wood
Uniden. dicotyledonous	small herb/vine	stem
Uniden. parenchymatous	tuber?, starchy tissue	stem/ tuber

wood, judging by the wide lumens and comparatively thin walls of fibers which comprise most of the surface area of the wood, is very tentatively identified as kapok or silk cotton (Ceiba pentandra). (Insufficient archaeological specimens are currently present with which to further the identificaton.) Finally, the Hope Estate remains include two small fragments of what appear to be soft parenchymatous tissue, perhaps the remains of starchy tuber or another form of storage tissue (such as endosperm).

Table 4.25 shows how the Hope Estate archaeobotanical identifications partition among the pair of proveniences that underwent analysis. Lignum-vitae occurs in both samples; it is the sole species recovered from Level 3a. Mirroring Wanapa, Hichmans' Site, Indian Castle, and Golden Rock, lignum-vitae is most abundant of the Hope Estate identifications (18 fragments total). The six other woods from Hope Estate are represented by less material (Table 4.25). Based on the present data, it is impossible to judge whether the lower frequencies of the other taxa are a reflection of relative importance, or, alternatively, of preservation biases and/or the differential effects of carbonization.

Beach Access Site, St. John, Virgin Islands

As with Hope Estate, only two samples were analyzed from the Beach Access Site (also known as Lameschur Bay), St. John (Table 4.26). The site has preceramic Archaic (Ortoiroid), as well as Saladoid (Huecan) components.

Table 4.25. Plant identifications from Hope Estate, St. Martin (by count).

IDENTIFICATION:	XVII A3 Lv.6	XXII T20 Lv.3a	TAXON TOTAL
cf. Gray nickers (wood)	3		3
cf. Fish poison (wood)	8		8
Lignum-vitae (wood)	8	10	18
Satinwood (wood)	2		2
Strong bark (wood)	4		4
Hope Estate-9 (wood)	1		1
Unid. dicot/vine (wood)	1		1
Unid. hardwood	1		1
Unid. parenchyma tissue	2		2
TOTAL WOOD TYPES:	7	1	
TOTAL SEEDS:	0	0	

Table 4.26. Archaeobotanical samples from Beach Access Site, St. John.

PROVENIENCE	CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD NO. IDEN.	TOTAL SEEDS	ARCHAEO. SEEDS
Feat.15, FS 223	hearth	-	71.4	-	71.4	17	0	0
Feat.18, FS 220	hearth	-	34.5	-	34.5	10	0	0
TOTALS:			105.9		105.9	27	0	0

Radiocarbon dates range from approximately 730 B.C. (corrected) to the first centuries A.D. (Ken Wild, personal communication, 17 December 1992).

Archaeobotanical samples from the Beach Access Site were removed from a pair of burned concentrations that are believed to have functioned as hearths (Ken Wild, personal communication 17 December 1992). All feature fill, including that from the pair of samples reported here, was sieved through 1/16 inch-mesh screens. The relatively coarse mesh size may account for the lack of seed remains in the samples that were analyzed.

Two wood types were recovered with the feature deposits from the Beach Access Site: buttonwood (<u>Conocarpus</u> <u>erectus</u>), and satinwood (<u>Zanthoxylum</u> sp.) (Table 4.27). The frequencies and distribution of the two woods from the Beach Access samples are shown in Table 4.28. Satinwood occurs in both features; buttonwood was indentified exclusively in Feature 15.

Satinwood's presence at the Beach Access site comprises the third record for the genus at a Saladoid site (including Golden Rock, Hope Estate, and Beach Access). In addition, fragments of satinwood were identified in wood remains from a later Ceramic Age occupation, specifically, the Suazoid Macabou site, Martinique (Newsom letter to Louis Allaire, 24 July 1986). Thus satinwood's presence in archaeological deposits is positively confirmed at four prehistoric sites

Table 4.27. Plant identifications from the Beach Access Site (Lameshur Bay), St. John.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Conocarpus erectus	buttonwood (mangle botón)	wood
Zanthoxylum sp.	satinwood (aceitillo)	wood

Table 4.28. Plant identifications from Beach Access Site, St. John (by count).

IDENTIFICATION:	Feat.15 FS 223	Feat.18 FS 220	TAXON TOTALS
Buttonwood (wood)	13		13
Satinwood (wood)	4	10	14
TOTAL WOOD TYPES:	2	1	
SEED TOTAL:	0	0	

in the Lesser Antilles, all of which belong to the Ceramic Age.

Trunk Bay, St. John, U.S. Virgin Islands

Two samples from Saladoid/Ostionoid Trunk bay were analyzed for evidence of prehistoric associations between plants and the human inhabitants of the site. The materials (Table 4.29) derive from general midden deposit; botanical specimens were analyzed in conjunction with faunal analyses that were undertaken at the Florida Museum of Natural History. Both samples were sieved through 1/16-inch mesh.

Four types of wood were recovered, including one wood that appears to belong to the bignonia family (Bignoniaceae) (Table 4.30). Three additional woods are represented by single fragments each, none of which is sufficient to produce definitive identifications. Trunk Bay-3 is possibly black mangrove (Avicennia germinans).

Two types of seed were recovered. Cockspur (Celtis iguanaea), the same as was documented from four sites mentioned above, is present in both samples (Table 4.31). The other seed type from Trunk Bay (one specimen) has been tentatively identified as kapok a/k/a silk-cotton tree (Ceiba pentandra). The latter is carbonized, while all cockspur seeds are apparently mineralized. Noteworthy from Level 6 are two small fragments of thoroughly burnt, flattened, parenchymatous tissue that lacks definable cellular structure. Under microscopic examination the tissue gives the impression of having been pulverized and

Table 4.29. Archaeobotanical samples from Trunk Bay, St. John.

PROVENIENCE	CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD NO. IDEN.	TOTAL SEEDS	ARCHAEO. SEEDS
Unit 1, Lv.5 FS 77	midden	-	12.18	-	5.82	7	5	5
Unit 1, Lv.6 FS 80	midden	-	10.69	-	8.23	5	5	5
TOTALS:			22.87		14.05	12	10	10

Table 4.30. Plant identifications from Trunk Bay, St. John, United States Virgin Islands.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
cf. Bignoniaceae	bignonia family	wood
cf. Ceiba pentandra	kapok, silk-cotton tree	seed
Celtis iguanaea*	cockspur (azufaifo)	seed
Uniden. wood-type 1	Trunk Bay-1, very small-diametered vessels (ca. <50 um); axial parenchyma confluent-banded, ca. 1/2 of ground mass	wood
Uniden. wood-type 2	Trunk Bay-2, vessels solitary, frequent; axial parenchyma sparse, apotracheal, rays uniseriate	wood
Uniden. wood-type 3	Trunk Bay-3, vessels small-diametered, prominently in chains, possibly Avicennia (black mangrove)	wood
Unid. ?pulverized tissue	?burnt cassava cake	(starch)

*Celtis seeds are mineralized.

Table 4.31. Plant identifications from Trunk Bay, St. John (by count).

IDENTIFICATION:	Unit 1 Lv.5 #77	Unit 1 Lv.6 #80	TAXON TOTALS
WILD EDIBLE:			
Cockspur	5	4	9
OTHER:			
cf.Bignoniac. (wood)	5	3	8
Kapok		1	1
Trunk Bay-1 (wood)	1		1
Trunk Bay-2 (wood)	1		1
Trunk Bay-3 (wood)		1	1
Uniden. starch tissue		2	2
TOTAL WOOD TYPES:	3	2	
SEED TOTAL:	1	5	
ARCHAEO. SEEDS:	1	5	

reworked into its present form. It is tempting to equate the unidentified tissue with cassava bread, and it may be so. Nevertheless, soft plant tissues that lack secondary xylem or other more resistant structure are subject to greater distortion upon drying and/or when exposed to heat. Thus, the unrecognizable state of the soft tissue could have resulted from carbonization, rather than by food preparation techniques. However, even soft tissues generally retain at least some anatomical structures, e.g. vascular bundles, that survive carbonization intact. Given the prevalence at Ceramic Age sites of clay griddles, purportedly used to cook starchy pastes into bread form over direct fire, it is likely that on occasion bits of the bread might have fallen into cooking fires, resulting in their preservation.

Summary of Results from Lesser Antilles Sites

Archaeobotanical data were compiled for twelve prehistoric sites in the Lesser Antilles. In the previous section, the results of these analyses were described according to geography, beginning with Wanapa, Bonaire, roughly at the southern extreme, and culminating with a pair of sites in the Virgin Islands. The emphasis shifts in the following section to view the archaeobotanical data in chronological and cultural perspective. Unavoidably, the twelve data sets are uneven, and the methods used to procure and process samples from the sites are often disparate. While this situation is not ideal, some generalizations are possible. Viewed together, the plant data provide insights

about plant exploitation over a broad span of time (at least three millennia), including the first broad-scale understanding of plant use by the various prehistoric inhabitants of the Lesser Antilles.

Plant identifications from the twelve sites discussed above are summarized in Tables 4.32 and 4.33. These data are supplemented with information from two additional sites. Wood identifications from Macabou, Martinique (Newsom letter to L. Allaire, 24 July 1986) are included with the plants listed in Table 4.33. In addition, Pearsall's (1983) identifications of wood and seed remains from Ortoiroid deposits at Krum Bay are included in the tables, as these data add significantly to the overall picture.

Plant Foods

Based on the present information, seed diversity for Ortoiroid to Suazoid series sites is relatively low, with no more than ten plant types identified among them (Table 4.32). This suggests that the range of wild plant foods exploited by Archaic and later Ceramic Age cultures in the Lesser Antilles was narrow. Such a broad generalization, however, must be applied with caution until additional data are gathered.

Positively identified edible plants from the Lesser Antilles sites include cockspur, mastic-bully, *Manilkara* sp., *Oenothera* sp., palm, and trianthema (the latter from Krum Bay; Table 4.32). A tentatively identified seed of the silk-cotton tree would add another to the list of plants

Table 4.32. Seeds and nonwood plant remains from sites in the Lesser Antilles.*

SCIENTIFIC/ COMMON NAME	PRECRAMIC: Twen Hill	Jol. Bea.	Hich. Shell	CERAMIC AGE SITES: Krum Bay+	Wan-apa	Pea-rls	Hey-wood	Hich. Site	Ind. Cas.	Gold Rock	Hope Est.	Bea. Acc.	Trunk Bay	NO. SITES
SEED TYPES:														
Cockspur	X					X			X	X			X	5
cf. silk-cotton													X	1
Manchioneel								X						1
Manilkara(sapod.)				X										1
Mastichodendron (mastic-bully)				X		X								2
Sapotaceae, cf. mastic-bully	X		X	X										3
Primrose			X											1
Palm family				(X)		X								2
Trianthema				X										1
Golden Rock typ.1										X				1
Golden Rock typ.2										X				1
MISCELLANEOUS:														
Dicotyl. herb/vine											X			1
Parenchym. tissue, possibly tuber											X			1
Pulverized tissue, possibly cassava													X	1

*Modern seeds excluded. Note that the category Sapotaceae consists of fragments of Manilkara and/or Mastichodendron seed coat that are too small to distinguish as separate genera. Additional seeds from Krum Bay, e.g., mallow and grass families (Pearsall 1989), are not included because of their prevalence in uncarbonized form at several sites, including those listed above (thus the seeds may have been relatively recently carbonized, or otherwise, may be indicental to the prehistoric occupations.

+Adapted from Pearsall 1989 (note that Krum Bay Mastichodendron originally was identified by C.E. Smith as Sterculia).

Table 4.33. Wood identifications from sites in the Lesser Antilles. (Numbers are site ubiquity; sites with few samples have identifications marked by presence/absence [x].)

SCIENTIFIC/ COMMON NAME	PRECRAMIC: Twen Hill	Jol. Bea.	Hich. Shell	CERAMIC AGE SITES: Krum Bay	Wan-apa	Pea-rls	Hey-wood	Mac-abou	Hich. Site	Ind. Cas.	Gold Rock	Hope Est.	Bea. Acc.	Tru. Bay
Black mangrove								X						
Bignoniac./cedar				39	51									
cf. Bignoniaceae							17							X
cf. Black torch											21			
Bombac./Malvac.							8							
Bourreria					24				(X)			X		
Boxwood					6									
Buttonwood				39	39								X	
cf. Caesalpinia												X		
Capparis				16	42									
cf. Capparis sp.				6	3									
Casearia					15									
cf. Celastraceae				61							5			
Clusia (Cupey)				26										
Croton				3							(10)			
cf. Dipholis	8										10			
Drypetes							8							
Fabaceae (Acacia)				29										
Fabaceae(Leucae.)				16										
Ficus (wild fig)				6										
Fish poison											10	(X)		
Flacourtiaceae					15									
Lignum-vitae					84				X	X	37	X		
Manchioneel							25							
cf. Meliaceae							16							

Table 4.33--continued.

SCIENTIFIC/ COMMON NAME	PRECRAMIC:			CERAMIC AGE SITES:										
	Twen Hill	Jol. Bea.	Hich. Shell	Krum Bay	Wan-apa	Pea-rls	Hey-wood	Mac-abou	Hich. Site	Ind. Cas.	Gold Rock	Hope Est.	Bea. Acc.	Tru. Bay
Myrtaceae							8							
Palm family							8							
Piper (Higuillo)				23										
Rubiaceae											10			
cf. Suriana											5			
White mangrove				45										
Zanthoxylum-1								X			21	X	X	
Zanthoxylum-2											10			
Heywoods-1							8							
Hope Estate-9												X		
Ind.Cast. 1-3										X				
Trunk Bay 1-3														X
Twen. Hill-1	8													
Wanapa 1-3					X									
TOTAL NO. WOOD TYPES:	2	0	0	12	12	0	8	2	2	4	10	5	2	4

with economic potential, if at some point the identification is verified with additional, better-preserved specimens. Cockspur, mastic-bully, species of Manilkara, and several types of palm provide abundant fruit that is edible fresh or may be preserved through dessication or fermentation (Balick 1984; Honychurch 1986:124; Little and Wadsworth 1964:34-40, 445-446, 454; Morton 1977; Rehm and Espig 1991:89-93, 231, 371).

Potherbs are represented by trianthema and Oenothera sp. (evening primrose) (Table 4.32). In both cases the whole plant is edible, including the small, dry seeds. Trianthema seeds are relatively high in protein (32.9% [Carr et al., 1985:510]). Evidence for trianthema's possible use by prehistoric human groups is stronger for sites in the Greater Antilles, discussed in Chapter 5.

Oenothera seeds have a high oil content (Carr et al., 1985:507-508) and are a rich source of tryptophan, a mildly sedative amino acid that probably is present in all higher plants (Duke 1992:7, 138-139). In addition, the seeds of at least one species are a major source of the nutrient gamma-linolenic-acid (GLA) (ibid.). To benefit from these compounds the seeds must be chewed and digested.

Aside from the seeds, the entire Oenothera plant is edible. The tap roots can be consumed raw or cooked (Duke 1992:138-139; Facciola 1990:144). Moerman (1986:309-311) lists ethnographic examples of various Oenothera species used in health care, from stomach to determatological

problems, and for ritual purposes. Although Moerman's data pertain to North American Indians, particularly southwestern groups like the Navaho and Zuni, similar uses of Oenothera plants may have occurred among Caribbean people. Oenothera is not among the numerous medicinal plants used or known to indigenous cultures from northwest Amazonia documented by Shultes and Raffauf (1990), by Ayala Flores (1984), or by Austin and Bourne (1992).

Oenothera in broader perspective

Oenothera sp. (Table 4.32) is an especially interesting identification not only because of its potential as a food and medicine, but because the plant's modern, apparently restricted, range contrasts with what seems to have been a much broader range in the past. Not only do species of Oenothera no longer occur in the West Indies aside from portions of Cuba, but the plant may never have occurred elsewhere in the Caribbean outside of human-modified settings, such as prehistoric homegardens (Covich and Nickerson 1966). Only one Oenothera seed was recovered in samples from the Lesser Antilles and it is associated with Archaic Age culture (i.e. Ortoiroid people living on the eastern coast of Nevis [Hichmans' Shell Heap, GE-6]). Evidence for prehistoric Oenothera is more compelling from deposits in the Greater Antilles (Chapter 5). The Hichmans' Oenothera seed is possible evidence that Archaic people gardened and/or tended the plants. There are many examples of gardening and incipient domestication of certain plants

by "Archaic" people at a similar level of cultural development in the Eastern Woodlands of North America (see, for example, B.D. Smith 1992) and in the American tropics (e.g., Callen 1965, 1967a, 1967b; Pickersgill 1989; Piperno 1989).

Alternatively, Oenothera may have been part of the naturally occurring vegetation of the West Indies, perhaps part of the ruderal flora that grew around human dwellings. Thus, Oenothera may have been initially collected in the wild, and possibly later became associated with household settings and/or homegardens (Covich and Nickerson 1966; Rindos 1984). At some point the plants may have been specifically protected, tended, and even propagated by Caribbean Indians. If Oenothera's continued existence on the various islands became dependent upon Caribbean Indians, then the plant may have disappeared from the region in conjunction with the loss of Native American culture that followed European contact. Nevertheless, current evidence is far too meager to suggest that Oenothera sp. was domesticated by (and, therefore, partially or wholly dependent upon) Taino people or their predecessors. An alternative hypothesis for the apparent eradication of primrose species from the Caribbean is that the plants disappeared in conjunction with extensive habitat destruction that has taken place over the past five centuries.

Widespread use and potential importance of Sapotaceae fruits

Two, possibly three, types of Sapotaceae fruit are represented in the Lesser Antillean sites. Mastichodendron foetidissimum (mastic-bully) was positively identified in midden samples from Krum Bay, St. Thomas, and from Pearls, Grenada, Ortoiroid and Cedrosan-Saladoid sites, respectively (Table 4.32). Similar or identical fragments of hard seed coat were recovered from two additional Ortoiroid sites: Twenty Hill, Antigua, and Hichmans' Shell Heap, Nevis. The seed coat fragments from the latter two sites are too small to determine whether they belong to Mastichodendron or to a related tree, Manilkara bidentata (bullet-wood [ausubo]), that has very similar seeds. Both trees are native to the region and widespread (Little and Wadsworth 1964:444, 454; Loigier and Martorell 1989); quite possibly both are represented in the seed fragments from the four sites.

Seeds from what clearly is a distinct species of Manilkara were identified by Pearsall (1983) in her analysis of plant remains from Krum Bay. Two whole Manilkara seeds from Krum Bay exhibit very linear, narrow hilums (see Figure C1 in Pearsall 1983) that are readily distinguished from the ovoid hilums of Mastichodendron and Manilkara bidentata. At least one additional native species of Manilkara occurs in the Virgin Islands: M. pleeana (zapote de costa) (Liogier and Martorell 1982:135). Another species, sapodilla (Manilkara zapota), is native to southern Mexico and Central America, but it has been long grown in the West Indies,

primarily for its large fruit (Johnson 1983; Liogier and Martorell 1982; Little and Wadsworth 1964:446; Martin et al. 1987; Mortensen and Bullard 1968). Sapodilla seeds possess a linear scar like the Krum Bay specimens. Nevertheless, without specimens of native M. pleeana with which to compare the archaeological material, the possibility must be left open that the seeds from Krum Bay are from a native Caribbean species. If, however, the Krum Bay seeds are shown to be Manilkara zapota, then they represent the earliest record in the Caribbean for a well-known, tropical American homegarden tree species (Berg 1984:147; Rico-Gray et al. 1990). Furthermore, the identification of sapodilla would comprise the first tentative confirmation of hypotheses that human migrants into the Caribbean archipelago transported and successfully established familiar plant resources in the new setting (Chapter 1), albeit at an earlier time--the Preceramic--rather than in the Ceramic Age as has been inferred by archaeologists. Note also that mastic-bully (Mastichodendron foetidissimum) and cockspur (Celtis iguanaea) likewise are recorded as homegarden tree species among the Maya of the Yucatan (Rico-Gray et al. 1990:483, 485). Unlike sapodilla, these two trees are generally regarded as native to the circum-Caribbean region, including the West Indies but not South America (Record and Hess 1943:507).

Cockspur seeds and interpretive problems

Described earlier were interpretative problems concerning cockspur, the most common of the seeds identified from the Lesser Antillean archaeological contexts (Table 4.32). In every case, the seeds are preserved by some degree of mineralization of the bony, calcareous seed coats. The difficulty in associating the seeds with the prehistoric settlements stems from the fact that during maturation Celtis sp. seeds secrete calcium carbonate, and also some silica (Green 1979; Steven Manchester, paleobotanist, personal communication). Thus Celtis seeds are virtually mineralized by the time of abscission. In the absence of evidence to the contrary, such as direct carbon-14 dates or a strong correlation with features and prehistoric activity areas, it is difficult to know whether the seeds are modern. Nevertheless, most evidence suggests a true and direct association between Celtis and the inhabitants of the various sites. The co-ocurrence at Pearls and Twenty Hill of cockspur seeds and mastic-bully (or, generally, Sapotaceae seed coats)--being two fresh-fruit resources--is possibly the strongest evidence for cockspur's having been used by prehistoric human groups in the Lesser Antilles. The Sapotaceae (including mastic-bully and species of Manilkara; Table 4.32) are more securely tied to the prehistoric deposits by the condition of the specimens (burnt, fragmented, associated with faunal food remains),

and in recognition of the great potential of the fruits as a food resource.

Wood Identifications from the Lesser Antilles

At least thirty types of wood were identified from archaeological deposits in the Lesser Antilles and the Netherlands island of Bonaire (Wanapa Site) (Table 4.33). Wood numbers in Table 4.33 are site ubiquity, on a per-site basis; identifications for sites with few remains are listed by presence (X) only. Data from Krum Bay, St. Thomas, are adapted from Pearsall (1983), and identifications from the Macabou Site, Martinique, are unpublished laboratory data (Newsom, personal communication to L. Allaire, 24 July 1986).

In terms of wood remains, the preceramic sites are generally underrepresented, with too few specimens identified to make generalizations. Only Krum Bay produced a significant amount of identifiable charcoal (Table 4.33), resulting in the identification of twelve different woods representative of coastal, dry deciduous, and semi-evergreen woodlands (Pearsall 1983).

The later Ceramic Period deposits provide more information (Table 4.33), and few patterns emerge from these data. Lignum-vitae (<u>Guaiacum</u> sp.) is the most ubiquitous wood among the Ceramic Age sites, including three Saladoid occupations--Hichmans' Site, Golden Rock, and Hope Estate--and Ostionoid Indian Castle (Table 4.33). At these sites lignum-vitae also is the most frequent identification.

Similarly, lignum-vitae wood dominates the record from Dabajuroid Wanapa (Bonaire).

Correspondence of two additional species occurs between the Wanapa Site and the Ceramic Age sites: one is strong bark (Bourreria sp.), found at three sites, and the other is buttonwood (Conocarpus erectus), found at two sites (Table 4.33). Likewise, four wood types are shared between Wanapa and preceramic Krum Bay. Use of the same woods across time and cultural boundaries is undoubtedly related to vegetation similarities and limited possibilities for species selection on the smaller, relatively arid islands.

Satinwood (Zanthoxylum spp.) is the second most frequently occurring wood overall. It was recovered from four sites, including Macabou, Martinique (mentioned briefly above). Following satinwood and appearing at three sites each are strong bark (Bourreria sp.) and black mangrove (Avicennia germinans) (including Indian Castle-2 and Trunk Bay-3). The remainder of the identifications are documented from only one or two sites.

The Golden Rock investigations provided the first opportunity to examine whether Saladoid people attempted to match specific woods with specific purposes or functions. Three woods from Golden Rock seem to have been used exclusively as the primary structural members for the Saladoid buildings: satinwood, tentatively identified black torch (Erithalis fruticosa), and a sapotaceous wood, probably bustic (Dipholis sp.). Lignum-vitae and bay cedar

(Suriana maritima) may also have served as posts or as other forms of construction material.

Five probable fuelwoods are identified from Golden Rock, including lignum-vitae, Celastraceae, fish poison (Piscida carthagenensis), pepper bush (Croton sp.), and Rubiaceae. Many of the species identified from the other sites (Table 4.33) probably also represent fuelwood. Fish poison potentially also was used to capture small fish and perhaps in ritual activity, as was discussed above in the section on Golden Rock. Rico-Gray et. al. (1990:479) found that fish poison is one of the primary constituents of Mayan homegardens, but did not explain the reason for fish poison's ubiquity or the nature of its use in the Mayan communities.

Further generalizations about wood selection and possible species preferences based on the present data from the Lesser Antilles would be too speculative, particularly since several of the sites are represented by too few samples and/or too few identifications. Nevertheless, a couple of additional points regarding the overall assemblages can be made. Some patterns of plant exploitation seem to transcend temporal and cultural boundaries. The edible fruits of at least three wild native trees--mastic-bully, cockspur, and at least one type of palm--were exploited by Archaic Age groups. Use of the same three fruits seems to carry through into the Ceramic Age. It is impossible to know, based on our present data, whether

the similar use of food resources is a case of cultural continuity and/or the transmission of information about edible plants, or simply represents a case of making similar use of readily available plant resources. Oenothera's presence in the Caribbean deposits may be a clearer case of the transmission of a plant and the knowledge pertaining to its use from one culture to the next. It remains to be demonstrated, however, that Oenothera was indeed specifically associated with prehistoric gardens, rather than having existed simply as a natural component of the weed flora that incidentally was taken up and used first by Ortoiroid people (Hichman's Shell Heap) and later by at least the Ceramic Age cultures of the Greater Antilles. Nevertheless, additional evidence supportive of a direct association between Caribbean people and Oenothera is presented in the next chapter.

CHAPTER 5

RESULTS OF ARCHAEOBOTANICAL ANALYSES: PUERTO RICO

Plant remains from the Greater Antilles are in general more abundant, and represent more species, than the sites in the Lesser Antilles. Consequently, archaeobotanical research on Greater Antilles sites is presented separately. The results of research with archaeobotanical collections from five sites on Puerto Rico are presented in this chapter, and the next chapter covers two sites on Hispaniola.

Two of the data sets from Puerto Rico are fairly extensive, while the other three sites are represented by few samples and/or few identifications. To compensate for the unevenness between sites, the data are considered broadly, documenting where and at what age the various plants appear. More sophisticated, quantative analyses must await additional data collection. The present synthesis is a gross, sub-regional perspective on plant use that undoubtedly will undergo revision as more data are gathered, but which serves as the first formulation of Ceramic-Age plant use in the Greater Antilles. Furthermore, these data together with the information presented in Chapter 6 provide the first verifications of the types of plants and

agricultural practices described in the early historic accounts of Taino people (Chapters 1 and 2).

As in the preceeding chapter, the sites and data presented here roughly follow geography and the migratory patterns of Ceramic Age people as established by Rouse (1989, 1992) and by others. First discussed are two sites located respectively on the northeastern and the north-central coasts of Puerto, specifically Calle Cristo and Maisabel (Figure 5.1). Next is El Fresal, a site in south-central Puerto Rico, followed by El Parking site, located further west, in the Cerrillos River Valley. The data and discussion of the the prehistoric sites are followed by a presentation of pertinent information from recent excavations of nineteenth-century deposits in Old San Juan. The chapter concludes with a summary of the archaeobotanical data from Puerto Rico, drawing also on information from two additional sites that were analyzed by other researchers (Maria de la Cruz cave [Cutler, in Rouse and Alegria 1990); El Bronce [Pearsall 1985]).

As indicated in Chapter 3, cultural affiliations of the sites reviewed below are more complex than was the case for the Lesser Antillean sites. All of the archaeobotanical assemblages analyzed by me in this chapter are attributed to Ceramic Age and/or later cultures, but plant identifications by Hugh Cutler from Archaic Age deposits in the Maria de la Cruz cave (Rouse and Alegria 1990) will be discussed in the final section of this chapter. Only one site, Maisabel

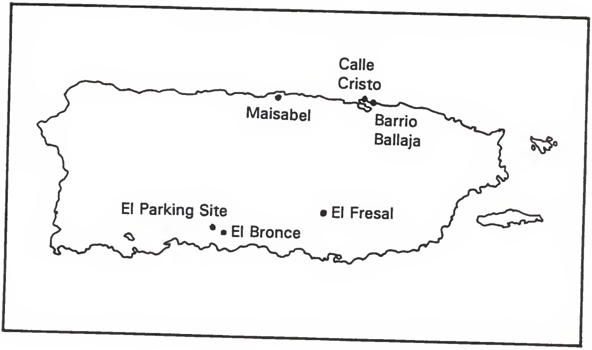


Figure 5.1. Locations of Puerto Rican sites analyzed for plant remains.

(Siegel 1990), has an early, Hacienda-Grande-Saladoid component; however, the related Cuevas subseries was identified at Calle Cristo (Newsom 1992b), Maisabel (Siegel 1989), and at the El Parking Site (PO-38) (Weaver 1992). Ostionoid culture is documented at all but Calle Cristo of the prehistoric sites, including the latest Esperanza, Capa, and Boca Chica subseries at at least one site (Meléndez 1988). Unfortunately, materials associated with the earliest occupants of the Greater Antilles--the Lithic/Archaic Age and the Casimiroid culture series (Callaghan 1990; Rouse 1992)--are not represented among the samples analyzed by me.

Puerto Rico Sites

Calle Cristo, San Juan, Puerto Rico

Eight samples from a small Saladoid-Cuevas site under Calle del Cristo, San Juan, were analyzed for evidence of prehistoric plant use (Table 5.1). All samples were processed by means of water flotation with fine-meshed screens. Unfortunately wood and seed remains are few. Four specimens of wood were found suitable for anatomical inspection. Thirteen seeds were recovered (Table 5.1), but all appear to be modern.

Table 5.2 lists the plant identifications from Calle del Cristo and Table 5.3 shows their distribution among the samples. One wood type (four specimens) can be reliably attributed to the archaeological occupation: the wood is bulley-tree (Pouteria sp. = Lucuma sp.). Preliminary

Table 5.1. Archaeobotanical samples from Calle del Cristo, San Juan, Puerto Rico. (Flotation samples 177 and 178 include both light and heavy fractions; other samples are exclusively light fractions.)

PROVENIENCE		CONTEXT	SAMPLE NO./FLOT.		SAMPLE VOLUME* (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	SEED DEN-SITY
N147/E153	55-65cm	midden	828	170	0.01	4.11	4.11	1.02	0	0	0	-
N144/E147	Stra.II	midden	908	171	0.05	26.11	26.11	3.60	0	0	0	-
N146/E147	Stra.III	midden	917	173	0.06	23.65	23.65	5.65	0	0	0	-
N144/E149	Stra.III	midden	921	175	0.11	34.47	34.47	2.52	0	0	0	-
N146/E149	Stra.III	midden	928	177-H	0.52	437.16	8.50	1.34	0	0	0	-
N144/E151	Stra.III	midden	935	180	0.10	40.12	40.12	10.80	2	0	0	-
N146/E149	Stra.IV	midden	930	178-H	0.42	304.23	4.53	(trace)	0	13	0	31
N144/E151	Stra.IV	midden	937	818	0.01	2.08	2.08	0.83	2	0	0	-
TOTALS:					1.27	871.93	143.57	25.76	4	13	0	

*Sample volume is, in this case, the light and/or heavy fraction volumes because the original pre-flotation whole-sample volumes are not available. The same applies to sample weights.

Table 5.2. Plant identifications from Calle del Cristo, San Juan, Puerto Rico.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Pouteria sp.	bully-tree (jácana/zapote)	wood
Unidentified hardwood		wood
Modern seeds:		
Malvaceae, *Malva/Sida*	mallow family (escoba)	seed
Poaceae, Panicoid	panicoid grass	seed
Poaceae, indeterminate	grasses, several types	seed

Table 5.3. Plant identifications from Calle del Cristo (by count).

IDENTIFICATION:	55-65 828/ 170	II 908/ 171	III 917/ 173	III 921/ 175	III 928/ 177	IV 930/ 178	III 935/ 180	IV 937/ 181	PLANT TOTAL	UBI-QUITY
WILD EDIBLE:										
Bully-tree							2	2	4	25
OTHER:										
Unid. hardwood	1	1	4	1	2	2	3			
Unid.soft tissue							2		2	13
MODERN SEEDS:										
Grass, indeter.						10			10	13
Grass, Panicoid						2			2	13
Mallow family						1			1	13
TOTAL NO. WOOD TYPES:	1	1	1	1	1	1	4	1		
SEED TOTAL:	0	0	0	0	0	13	0	0		
ARCHAEO. SEEDS:	0	0	0	0	0	0	0	0		

descriptive-anatomical analysis of other wood specimens from Calle Cristo indicates that several types of tropical hardwood are present, but the individual fragments are not identifiable.

Bulley-tree is closely related to the Sapotaceae genera identified from the sites described in Chapter 4, specifically mastic-bully (*Mastichodendron foetidissimum*) and bullet-wood/sapodilla (*Manilkara* spp.). Likewise, species of *Pouteria* are important tropical American homegarden trees (Denevan and Treacy 1987; Johnson 1983; Lazos Chavero and Alvarez-Buylla Roces 1988; Martin et al. 1987; Rico-Gray 1990).

Three native species of *Pouteria* are recorded for Puerto Rico (Liogier and Martorell 1982:136); all bear edible fruit. *Pouteria sapota*, zapote or red mammee, is a well known species that is planted at lower elevations in Puerto Rico, but has not become naturalized (ibid.). Unfortunately, it is impossible to distinguish by wood anatomy which species of *Pouteria* sp. is or are present in the Calle Cristo samples.

Maisabel, Puerto Rico

Maisabel is a large settlement and burial site on the north coast of Puerto Rico (Chapter 3; Figure 5.1). Peter Siegel's excavations revealed that the occupation at Maisabel began with the early Saladoid Hacienda Grande culture and continued apparently uninterrupted into the

later Ostionoid subseries (including Santa Elena and Esperanza complexes [Chapter 3]) (Siegel 1989, 1990).

Archaeobotanical analysis of Maisabel deposits currently extends to 45 samples representing 40 proveniences (Table 5.4). Twenty-one samples come from Mounded Midden 1, which is associated entirely with the Hacienda Grande complex (Siegel 1990). Two samples, Carbon numbers 100 and 131 (Table 5.4), were recovered from beneath Mounded Midden 1. These apparently predate the Saladoid occupation of Maisabel based on the lack of associated cultural material and on the radiocarbon dates, all being older than approximately 2200 years before present (see end notes for Table 5.4; and see Siegel 1990). The rest of the samples come from areas of the site, e.g., the central cemetary (Chapter 3), that were continuously used from Hacienda Grande to Ostionoid times. Thus, it is difficult to assign the individual samples to particular temporal and cultural series due to the admixture of cultural materials representative of different phases of occupation. For example, Carbon Sample 253 from the Mound 2 area is assigned to the Hacienda Grande complex based on the associated ceramics; likewise, Carbon Sample 228 is an Ostionoid pit, judging by the Ostiones-style ceramics (Table 5.4), but other Mound 2 contexts are not clearly or definitively tied to either of the culture series. Four flotation samples derive from the large ditch feature that encircled an Ostionoid-aged house-structure (Chapter 3). Finally,

Table 5.4. Maisabel, Puerto Rico: samples analyzed for archaeobotanical data.

LOCATION	PROVENIENCE (unit/feat./depth)	CULTURAL AFFILIATION (subseries/complex)	SAMPLE CONTEXT	---SAMPLE-- NO.	TYPE
Macrob. house	N042/W14, Feat. 101	Elenan Ostionoid	ditch	749	float
Macrob. house	N042/W18, Feat. 101	Elenan Ostionoid	ditch	742	float
Macrob. house	N043/W08, Feat. 101	Elenan Ostionoid	ditch	770	float
Macrob. house	N043/W10, Feat. 101	Elenan Ostionoid	ditch	763	float
Macrob., east	N042/E02, Area A, 60-70	Cuevas to Santa Elena	feature	334	carbon
Macroblock	N036/W10, Feat. 95, 60-70	Hac. Grande to San. Ele.**	?hearth	326	carbon
Macroblock	N036/W10, Feat. 95, 70-80	" "	"	330	carbon
Macroblock	N036/W10, Feat. 95, 70-80	" "	"	332	carbon
Macroblock	N042/W10, Feat. 160 lv.24	Hac. Grande to San. Ele.	feature	321	carbon
Macroblock	N042/W10, Feat.163, 70-80	Hac. Grande to San. Ele.	feature	325	carbon
Macroblock	N042/W10, lv. 80-90	Hac. Grande to San. Ele.	gen.lev.	327	carbon
Macroblock	N042/W12, lv. 50-80	Hac. Grande to San. Ele.	gen.lev.	333	carbon
Cemetery	N032/E32, lv. 30-40	Cuevas	gen.lev.	353	float
Mound 2, side	N002/W07, Feat. 38, 74-79	Ostionoid, Ostiones **	pit	228	carbon
Mound 2, side	N002/W09, lv. 60-70	Hacienda Grande	gen.lev.	253	carbon
Mound 2, top	S038/W18, lv. 20-30	Cuevas to Santa Elena	gen.lev.	311	float
Mound 2, top	S038/W18, lv. 30-40	Cuevas to Santa Elena	gen.lev.	321	float
Mound 2, top	S038/W18, lv. 40-50	Cuevas to Santa Elena	gen.lev.	336	float
Mound 2, top	S038/W18, lv. 50-60	Cuevas to Santa Elena	gen.lev.	346	float
Mound 2, top	S038/W18, lv. 60-70	Cuevas to Santa Elena	gen.lev.	351	float
Mound 2, top	S038/W18, lv. 80-90	Cuevas to Santa Elena	gen.lev.	364	float
Midden 3	N112/W88, Feat.104, 90-100	Hac. Grande to ?Monser.	feature	588	float
Mound. Mid.1	N092/W13, lv. 40-50	Hacienda Grande	gen.lev.	107	carbon
Mound. Mid.1	N092/W13, lv. 40-50	Hacienda Grande	gen.lev.	112	carbon
Mound. Mid.1	N092/W13, lv. 50-60	Hacienda Grande	gen.lev.	116	carbon
Mound. Mid.1	N096/W13, lv. 0-20	Hacienda Grande	gen.lev.	85	float
Mound. Mid.1	N096/W13, lv. 20-30	Hacienda Grande	gen.lev.	68	float
Mound. Mid.1	N096/W13, lv. 40-50	Hacienda Grande	gen.lev.	55	float
Mound. Mid.1	N096/W13, lv. 50-60	Hacienda Grande	gen.lev.	77	float

Table 5.4--continued.

LOCATION	PROVENIENCE (unit/feat./depth)	CULTURAL AFFILIATION (subseries/complex)		SAMPLE CONTEXT	---SAMPLE-- NO.	TYPE
Mound. Mid.1	N096/W13, lv. 60-70	Hacienda Grande		gen.lev.	80	float
Mound. Mid.1	N096/W13, lv. 70-80	Hacienda Grande		gen.lev.	91	float
Mound. Mid.1	N096/W13, lv. 80-90	Hacienda Grande		gen.lev.	88	float
Mound. Mid.1	N096/W13, lv. 90-100	Hacienda Grande		gen.lev.	95	float
Mound. Mid.1	N096/W13, lv. 100-110	Hacienda Grande		gen.lev.	70	float
Mound. Mid.1	N096/W13, lv. 110-120	Hacienda Grande		gen.lev.	92	float
Mound. Mid.1	N096/W13, lv. 120-130	Hacienda Grande		gen.lev.	84	float
Mound. Mid.1	N096/W13, lv. 140-150	Hacienda Grande		gen.lev.	60	float
Mound. Mid.1	N096/W13, lv. 150-160	Hacienda Grande		gen.lev.	75	float
Mound. Mid.1	N098/W13, lv. 30-40	Hacienda Grande		gen.lev.	62	float
Mound. Mid.1	N098/W13, lv. 150-160	Hacienda Grande		gen.lev.	93	carbon
Mound. Mid.1	N100/W13, Feat.12, 140-150	Hacienda Grande	**	feature	95	carbon
Mound. Mid.1	N102/W13, lv. 130-140	Hacienda Grande		gen.lev.	87	carbon
Mound. Mid.1	N106/W12, lv. 30-40	Hacienda Grande		gen.lev.	129	carbon
Mound. Mid.1	N090/W13, lv. 150-160	pre-occupation	**	gen.lev.	131	carbon
Mound. Mid.1	N100/W13, lv. 150-160	pre-occupation	**	gen.lev.	100	carbon

**Radiocarbon dates: Sample 228 = 1240+/-80 (I-14748); Feature 95 samples = 1260+/-60, 1150+/-70, 1300+/-70, 1440+/-70 (Beta-17638 to -17641); Carbon Samp. 131 = 2810+/-70 (Beta-14998), 3340+/-90 (I-14745); Carbon Samp. 100 = 2300+/-80 (Beta-14996), 2270+/-80 (I-14744); Carbon Samp. 94 (same Feature 12 as Carbon Samp. 95) = 1960+/-90 (Beta-14381). (Radiocarbon years before present; all dates uncorrected, see Siegel [1990] for calibrations.)

Flotation Sample 353 (Table 5.4) from the central cemetery is associated with the Cuevas complex based on ceramic typology; the cemetery as a whole seems to have been used from the Hacienda Grande through the Santa Elena occupations.

Wood remains from Maisabel are exceptionally well preserved, but did not survive flotation in identifiable condition. Therefore, wood identification focused on the carbon samples, which did not undergo similar moisture stress and the resultant fragmentation. All together, 290 individual fragments of wood have been identified (Table 5.5). Archaeological seeds and other non-wood remains are few and sparsely distributed among the samples analyzed thus far.

Ten different plants are identified from the excavations at Maisabel (Table 5.6). Non-wood remains include palm petiole (the stem portion of the frond) and several types of seeds. Only one of the positively identified seeds may be contemporaneous with the archaeological occupation of the site: trianthema (<u>Trianthema</u> <u>portulacastrum</u>) (Table 5.6), the same as was recovered from the Krum Bay excavations described earlier in Chapter 4 (Table 4.32). Modern-intrusive seeds are fairly abundant in the flotation samples, but trianthema is not among the non-carbonized specimens.

The bulk of prehistoric plant remains from Maisabel is wood. At least eight wood types are present (Table 5.6),

Table 5.5. Archaeobotanical samples from Maisabel, Puerto Rico.

PROVENIENCE (coordinates/depth)	SAMP. NO.	SAMPLE TYPE	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	SEED DEN-SITY
N042/W14, Fea.101 ditch	749	float	10.0	-	(trace)	(trace)	1	26	0	-
N042/W18, Fea.101 ditch	742	float	10.0	-	(trace)	(trace)	-	4	0	-
N043/W08, Fea.101 ditch	770	float	10.0	-	(trace)	(trace)	-	14	0	-
N043/W10, Fea.101 ditch	763	float	10.0	-	(trace)	(trace)	-	2	0	-
N042/E02, Area A, 60-70	334	carbon	-	181.0	-	(trace)	6	0	0	-
N036/W10, Fea.95, 60-70	326	carbon	0.15	136.5	-	28.5	20	0	0	-
N036/W10, Fea.95, 70-80	330	carbon	-	535.0	-	48.0	20	0	0	-
N036/W10, Fea.95, 70-80	332	carbon	-	534.5	-	103.0	20	0	0	-
N042/W10, Fea.162, 24 cm	321	carbon	0.04	33.2	-	(trace)	10	0	0	-
N042/W10, Fea.163, 70-80	325	carbon	0.65	36.0	-	35.4	20	0	0	-
N042/W10, lv. 80-90	327	carbon	-	536.5	-	15.0	20	0	0	-
N042/W12, lv. 50-80	333	carbon	-	(trace)	-	(trace)	1	0	0	-
N032/E32, lv. 30-40	353	float	10.0	-	(trace)	(trace)	-	9	0	-
N002/W07, Fea.38, 74-79	228	carbon	1.2	1116.0	-	204.7	30	0	0	-
N002/W09, lv. 60-70	253	carbon	0.20	150.0	-	(trace)	30	0	0	-
S038/W18, lv. 20-30	311	float	10.0	-	(trace)	(trace)	-	10	2	0.2
S038/W18, lv. 30-40	321	float	9.0	-	(trace)	(trace)	-	10	0	-
S038/W18, lv. 40-50	336	float	11.0	-	(trace)	(trace)	-	36	2	0.2
S038/W18, lv. 50-60	346	float	11.0	-	(trace)	(trace)	-	4	0	-
S038/W18, lv. 60-70	351	float	9.0	-	(trace)	(trace)	-	12	1	0.1
S038/W18, lv. 80-90	364	float	9.0	-	(trace)	(trace)	-	10	1	0.1
N112/W88, Fea.104, 90-100	588	float	11.0	-	(trace)	(trace)	-	4	0	-
N092/W13, lv. 40-50	107	carbon	0.05	69.5	-	(trace)	4	0	0	-
N092/W13, lv. 40-50	112	carbon	0.02	49.1	-	1.7	3	1	0	-
N092/W13, lv. 50-60	116	carbon	0.05	85.0	-	(trace)	1	0	0	-
N096/W13, lv. 0-20	85	float	3.0	-	(trace)	(trace)	-	2	0	-
N096/W13, lv. 20-30	68	float	3.0	-	(trace)	(trace)	-	0	0	-
N096/W13, lv. 40-50	55	float	3.5	-	(trace)	(trace)	-	1	0	-
N096/W13, lv. 50-60	77	float	4.0	-	(trace)	(trace)	-	8	0	-

Table 5.5--continued.

PROVENIENCE (coordinates/depth)	SAMP. NO.	SAMPLE TYPE	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	SEED DEN-SITY
N096/W13, lv. 60-70	80	float	4.0	-	(trace)	(trace)	-	2	0	-
N096/W13, lv. 70-80	91	float	5.0	-	(trace)	(trace)	-	0	0	-
N096/W13, lv. 80-90	88	float	5.0	-	(trace)	(trace)	-	5	0	-
N096/W13, lv. 90-100	95	float	3.0	-	(trace)	(trace)	-	0	0	-
N096/W13, lv. 100-110	70	float	3.0	-	(trace)	(trace)	-	1	0	-
N096/W13, lv. 110-120	92	float	3.0	-	(trace)	(trace)	-	0	0	-
N096/W13, lv. 120-130	84	float	4.0	-	(trace)	(trace)	-	0	0	-
N096/W13, lv. 140-150	60	float	2.0	-	(trace)	(trace)	-	1	0	-
N096/W13, lv. 150-160	75	float	2.0	-	(trace)	(trace)	-	0	0	-
N098/W13, lv. 30-40	62	float	3.0	-	0.84	0.5	-	0	0	-
N098/W13, lv.150-160	93	carbon	-	1665.0	-	18.8	20	0	0	-
N100/W13, Fea.12, 140-150	95	carbon	-	1816.0	-	91.6	30	8	1	-
N102/W13, lv.130-140	87	carbon	-	193.0	-	1.1	2	0	0	-
N106/W12, lv. 30-40	129	carbon	<.01	8.1	-	(trace)	2	0	0	-
N090/W13, lv.150-160	131	carbon	-	1299.0	-	20.5	20	0	0	-
N100/W13, Lv.150-160	100	carbon	-	1568.0	-	163.0	30	2	0	-
TOTALS:			169.86	10011.40	0.84	731.8	290	172	7	

Table 5.6. Plant identifications from Maisabel, Puerto Rico.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Bignoniaceae, *Tabebuia* or *Cresentia*	bignonia family, white cedar or calabash tree	wood
Cassine xylocarpa	marble-tree (guayarote)	wood
cf. *Inga* sp.	guaba	wood
Montezuma grandiflora	maga, maga wood	wood
Palmae	palm family	petiole
Pouteria sp.	bully-tree (jácana, zapote)	wood
cf. *Psidium* sp.	guava (guayaba)	wood
cf. *Sterculia apetala**	panama-tree (anacagüita)	wood
Trianthema portulacastrum	trianthema (verdolaga de hoja ancha)	seed
semi-ring porous hardwood, e.g. *Ficus*	Maisabel-1 (fig [jagüello])	wood
Unidentified hardwood		wood
Unid. seed/fruit		seed
Modern seeds:		
Aizoaceae		seed
Bidens sp.	beggar-ticks (alfilerillo)	seed
Desmodium sp.	trefoil (zarzabacoa)	fruit
Fabaceae	bean family, cf. *Cassia* sp.	seed
Malvaceae	mallow family, e.g. *Sida*	seed
Palmae	palm family	seed
Poaceae, awned	grass family	seed
Poaceae, plumed	grass family	seed
Poaceae, panicoid	grass family, e.g. *Paspalum*	seed
Poaceae, panicoid	grass family, e.g. *Setaria*	seed
Unid. modern		seed

*native of northern South America (Liogier and Martorell 1982)

including a wood belonging to the Bignoniaceae that closely compares with two genera (Tabebuia sp. and Cresentia sp.), marble-tree (Cassine xylocarpa), maga (Montezuma grandiflora), and bully-tree (Pouteria sp.). Pouteria sp. was identified also in the Calle Cristo samples, described above. Three wood taxa from Maisabel samples are provisional identifications. The tentative types include a tree-legume, probably Inga sp., guava (Psidium sp.), and panama-tree (Sterculia apetala). The eighth wood from Maisabel is temporarily designated Maisabel-1 (Table 5.6). Maisabel-1 is anatomically similar to fig (Ficus spp.), but based on the present sample can not be definitively distinguished from other woods with strongly confluent-banded parenchyma.

Table 5.7 shows the Maisable plant identifications by their respective proveniences. The category "unidentified soft tissue" includes all carbonized, non-woody tissue, some of which is possibly starch extruded from seeds or tubers, or wood exudate. Samples designated "F#" in Table 5.7 are flotation samples; samples with no identifiable plant remains are excluded from the table and are not included in the ubiquity values. Note also that ubiquity is figured separately for carbon and for flotation samples from Maisabel, because of differential sample treatment and processing (as described above).

Bully-tree wood is ubiquitous in Maisabel deposits, with 215 fragments identified (74% of the total) and

Table 5.7. Plant identifications from Maisabel deposits (by count).

IDENTIFICATION:	MACROBLOCK: -----Ditch with Ostion. House------					-----N036/W10------			
	N042/W14	N042/W18	N043/W08	N043/W10	N042/E02				N042/W10
	Fea.101	Fea.101	Fea.101	Fea.101	Area A	Fea.95	Fea.95	Fea.95	Fea.162
CULTIVATED:	F#749	F#742	F#770	F#763	#334	#326	#330	#332	#321
cf. Guava									
cf. Panama-tree									
WILD EDIBLE:									
Bully-tree						20	20	20	
Palm (frond)	1								
Trianthema									
OTHER:									
Bignoniaceae									
cf. Guaba									
Maga					6				10
Marble-tree									
?Fig (wood)									
Unid. hardwood	1	1	1	1					
Unid. seed/pit									
Ud. soft tissue									
MODERN SEEDS:									
Azioaceae									
Beggar-ticks									
Grass, awned	12		14	2					
Grass, plumed									
cf. Paspalum									
cf. Setaria									
Mallow family	7	1							
Trefoil	1	1							
Unid. modern	6	2							
# WOOD TYPES:	1	1	1	1	1	1	1	1	1
SEED TOTAL:	26	4	14	2	-	-	-	-	-
ARCHAEO. SEEDS:	0	0	0	0	-	-	-	-	-

Table 5.7--continued.

IDENTIFI-CATION:	MACROBLOCK (continued) ---N042/W10-- Fea.163 #325	80-90 #327	N042/W12 50-80 #333	CEME-TERY N032/E32 30-40 F#353	MOUNDED-MIDDEN 2: side N002/W07 Fea.38 #228	side N002/W09 60-70 #253	top --S038/W18-- 20-30 F#311	top 30-40 F#321
CULTIVATED:								
cf. Guava								
cf. Panama-tree								
WILD EDIBLE:								
Bully-tree	20	20			30	1		
Palm (frond)								
Trianthema							1	
OTHER:								
Bignoniaceae						1		
cf. Guaba						1		
Maga						8		
Marble-tree								
?Fig (wood)						18		
Unid. hardwood			1	1		1	1	1
Unid. seed/pit							1	
Ud. soft tissue							2	3
MODERN SEEDS:								
Azioaceae								
Beggar-ticks								
Grass, awned				8			7	
Grass, plumed								
cf. Paspalum								2
cf. Setaria								8
Mallow family								
Trefoil								
Unid. modern				1			1	
# WOOD TYPES:	1	1	1	1	1	5	1	1
SEED TOTAL:	-	-	-	9	-	-	10	10
ARCHAEO. SEEDS:	-	-	-	0	-	-	2	0

Table 5.7--continued.

IDENTIFI-CATION:	top	top	top	top	MIDDEN 3	MOUNDED-MIDDEN 1:				
	---------S038/W18---------				N112/W88	-----N092/W13----			-N096/W13-	
	40-50	50-60	60-70	80-90	90-100	40-50	40-50	50-60	0-20	40-50
CULTIVATED:	F#336	F#346	F#351	F#364	#588	#10	#112	#116	F#85	F#55
cf. Guava										
cf. Panama-tree										
WILD EDIBLE:										
Bully-tree						4				
Palm (frond)										
Trianthema										
OTHER:										
Bignoniaceae										
cf. Guaba										
Maga							2			
Marble-tree										
?Fig (wood)										
Unid. hardwood	1	1	1	2	1		1	1	1	1
Unid. seed/pit	2		1	1						
Ud. soft tissue	1		3	1						6
MODERN SEEDS:										
Azioaceae					2					
Beggar-ticks										
Grass, awned	5	1	6	4	2					1
Grass, plumed			4	1						
cf. Paspalum	1			3					2	
cf. Setaria	6			1						
Mallow family	1		1							
Trefoil										
Unid. modern	21	3								
# WOOD TYPES:	1+	1	1	2	1	1	1	1	1	1
SEED TOTAL:	36	4	12	10	4	-	-	-	2	1
ARCHAEO. SEEDS:	2	0	1	1	0	-	-	-	0	0

Table 5.7--continued.

IDENTIFICATION:	MOUNDED-MIDDEN 1: (continued) --N096/W13-- 50-60 F#77	60-70 F#80	80-90 F#88	90-100 F#95	100-110 F#70	140-150 F#60	--N08/W13-- 30-40 F#62	150-160 #93	N100/W13 Fea.12 #95
CULTIVATED:									
cf. Guava									
cf. Panama-tree									
WILD EDIBLE:									
Bully-tree								20	30
Palm (frond)									
Trianthema									
OTHER:									
Bignoniaceae									
cf. Guaba									
Maga									
Marble-tree									
?Fig (wood)									
Unid. hardwood	1	1	1		1	0	1		
Unid. seed/pit									1
Ud. soft tissue	1	4	5	1	1		1		1
MODERN SEEDS:									
Azioaceae									
Beggar-ticks									1
Grass, awned	8	2							1
Grass, plumed									
cf. Paspalum									3
cf. Setaria									
Mallow family									1
Trefoil									
Unid. modern						1			1
# WOOD TYPES:	1	1	1	0	1	0	1	1	1
SEED TOTAL:	8	2	5	0	1	1	0	-	8
ARCHAEO. SEEDS:	0	0	0	0	0	0	0	-	1

Table 5.7--continued.

IDENTIFI-CATION:	--BELOW MOUND 1-- N102/W13 130-140 #87	N106/W12 30-40 #129	N090/W13 150-160 #131	N100/W13 150-160 #100	MOUNDED MIDDEN-1 PLANT TOTAL	OVERALL PLANT TOTAL	OVERALL UBI-QUITY
CULTIVATED:							
cf. Guava			19		19	19	6
cf. Panama-tree	2				2	2	6
WILD EDIBLE:							
Bully-tree				30	84	215	56
Palm (frond)					0	1	5
Trianthema					0	1	5
OTHER:							
Bignoniaceae					0	1	6
cf. Guaba					0	1	6
Maga					2	26	25
Marble-tree		1			1	1	6
?Fig (wood)					0	18	6
Unid. hardwood		1	1				
Unid. seed/pit							
Ud. soft tissue							
MODERN SEEDS:							
Azioaceae					0	2	5
Beggar-ticks					1	1	5
Grass, awned				2	14	75	72
Grass, plumed					0	5	11
cf. Paspalum					5	11	28
cf. Setaria					0	15	17
Mallow family					1	11	22
Trefoil					0	2	5
Unid. modern							
# WOOD TYPES:	1	2	1	1	5		
SEED TOTAL:	-	-	-	2	22		
ARCHAEO. SEEDS:	-	-	-	0	1		

appearing in 56% of the samples with identifiable wood. Maga is second in frequency of occurrence, appearing in four proveniences (Table 5.7). Each of the other six wood types is restricted to single depositional contexts. The plant identifications from Maisabel are reviewed below by provience to facilitate the interpretation of their presence at the site.

Sub-midden levels

Carbon Sample 131 is from Level 150-160 cmbs (centimeters below surface), which is below the base of Mounded Midden 1. Currently, this is the sole context from which the tentatively identified guava wood (cf. Psidium sp.; Tables 5.6, 5.7) was recovered. Carbon Sample 100 came from essentially the same stratum as sample 131 and likewise either predates, or belongs to, the initial stages of human occupation at the site. Bully-tree is the only wood present in sample 100 (note that Carbon Sample 93 is from a similar depth and contains exclusively bully-tree wood, but this latter sample does not definitively predate the construction of the mounded midden).

Species of Psidium and Pouteria--the two genera from below the occupation levels at Maisabel--are planted widely in the tropics and have been long associated with Native American gardens and cultivation. Whether the wood specimens from Maisabel came from wild or from some of the better-known homegarden and orchard tree species of tropical America (see, for example, Austin and Bourne 1992; Denevan

and Treacy 1987) is an important consideration. Wild species of both genera occur in the Caribbean, Puerto Rico, and other areas of the neotropics (Liogier and Martorell 1982; Record and Hess 1943; Little and Wadsworth 1964; Little, Woodbury, and Wadsworth 1974). Unfortunately it is not possible to distinguish by wood anatomy whether the bully-tree and guava-type specimens from Maisabel deposits came from native or exotic species. The latter is less likely given that the woods were recovered from deposits that apparently formed prior to the development of the settlement at Maisabel, and presumably also the importation of plants by Saladoid people. However, the possibility exists that cultivated or otherwise valued plants were earlier transported during the Lithic and Archaic Age migrations to Puerto Rico by Casimiroid and Ortoiroid people, or by birds or other natural means. Thus, the true nature of the guava-type wood and earliest bulley-tree specimens at Maisabel remains uncertain until more data are gathered. For now these taxa may best be considered native, wild species.

A few additional points concerning guava and bully-tree need to be made. Two of the three species of guava (Psidium spp.) listed for Puerto Rico are considered endemic (Liogier and Martorell 1982:125): P. insulanum to East Point and Vieques Island, and P. sintenisii (considered rare) to high-elevation mountain forests in the eastern and western portions of the island (ibid.; Little, Woodbury, and

Wadsworth 1974:682). The respective ranges of these two species are exclusive of the north-coastal region where Maisabel is located. Therefore, unless the endemic Psidium spp. once had broader ranges that included the northern coastal plain or they were specifically transported by humans, it is probable that the wood from Maisabel belongs to the species P. guajava (assuming that the genus identification proves correct). Psidium guajava is considered native to the Caribbean and the adjacent mainland (Martin et al., 1987:42; Mortensen and Bullard 1968:36; Rehm and Espig 1991:194), and varieties of this guava species are cultivated throughout the tropics (Martin et al., 1987; Mortensen and Bullard 1968; Popenoe 1939; Rehm and Espig 1991). Similarly, native Pouteria multiflora (bully-tree/jacana) is a common component of lower and middle elevation wet and moist forests (Ashton 1985:99; Loigier and Martorell 1982:136); this species could well be the wood recovered in the Maisabel samples.

Hacienda Grande deposits from Maisabel

Hacienda Grande deposits from Mounded Middens 1 and 2 contain at least eight archaeological plant types. Hacienda Grande samples from Mounded Midden 1 include Carbon Sample 107 and all subsequently listed samples in Table 5.7, except for numbers 100 and 131 from the sub-mound strata that were discussed above; Carbon Sample 253 from Mounded Midden 2 is Hacienda Grande aged. A single carbonized seed fragment was recovered from among these samples (in the residuum of

Carbon Sample 95). The fragment is reminiscent of small sized seeds from certain wild legumes, but it has not been identified. Wood remains from the Hacienda Grande components include bully-tree (apparently the same as was discussed above), maga, marble-tree, Bignoniaceae, the fig-like Maisabel-1, and provisional identifications of guaba and panama-tree (Tables 5.6, 5.7).

Except for bully-tree, which occurs in four of the six Haciende Grande samples with identifiable wood, the wood taxa in the Hacienda Grande deposits are very restricted in their occurrences. Carbon Samples 87 and 129 (Table 5.7) are the only contexts for Panama-tree and for marble-tree, respectively. Likewise, Carbon Sample 253 from Mounded Midden 2 is the only context from which the Bignoniaceae wood, cf. Inga sp. (guaba), and Maisabel-1 were recovered. Carbon Sample 253 happens also to be the most species rich of the entire assemblage, with at least five types of wood identified (Table 5.7). The greater diversity in Sample 253 possibly is an indication that the wood fragments originated as fuelwood. Maga was recovered in Carbon Sample 253 from Mounded Midden 2, and from Carbon Sample 112 of Mounded Midden 1.

According to Liogier and Martorell (1982:104), maga (Montezuma grandiflora; Table 5.6) is endemic to Puerto Rico. Record and Hess (1943:352) report that maga is used locally for fence posts and piling. With the exception of Panama-tree, which is discussed below, the other woods from

the Haciende Grande deposits at Maisabel are either native or highly likely to derive from native, as opposed to imported, species (for example, exotic species of Inga sp. listed for Puerto Rico [Liogier and Martorell 1982:58] were imported and planted primarily for shade in coffee plantations, a relatively recent enterprise).

The possible presence of Panama-tree (Sterculia apetala) at Maisabel is especially noteworthy. Panama-tree is a member of the chocolate family (Sterculiaceae). It is closely related to cacao (Theobroma cacao) and to guacima/West Indian elm (Guazuma ulmifolia), both of which are cultivated in Central and South America (Hiraoka 1985; Lazos Chavero and Alvarez-Buylla Roces 1988; Posey 1984). The seeds of Panama-tree are edible when ground; they can be made into a beverage, and, when roasted, the seeds are reported to taste like peanuts (Little and Wadsworth 1964:340; Martin et al., 1987:122). Sterculia apetala is considered native to northern South America (Little and Wadsworth 1946:340; Loigier and Martorell 1982:108). Thus, panama-tree may have been first carried into the Caribbean archipelago by Saladoid migrants. Unfortunately for now the identification of Panama-tree is provisional. When the archaeobotanical analysis is expanded to include additional samples, the tree's presence at the site may be affirmed.

Cuevas sample

One sample from the cemetery at Maisabel is associated with the Cuevas complex, as mentioned above. Unfortunately,

the single fragment of hardwood that was recovered is not identifiable. Nine seeds are present, but all are modern and intrusive (Table 5.7).

<u>Ostionoid-aged contexts from Maisabel</u>

Only two definitively later Ceramic Age Ostionoid contexts have currently been examined for plant remains. One of these is Feature 38 from the Mounded-Midden-2 area, and the other is the ditch-feature (four individual samples; Table 5.4) that appears to have surrounded the Ostionoid house. Combined, there is little to discuss from these samples since they produced few identifiable archaeological specimens (Tables 5.6 and 5.7). Bully-tree wood is present (Feature 38), apparently the same as appears in the earlier-aged contexts described above. Other plant materials from the Ostionoid samples include four small fragments of unidentifiable hardwood (not necessarily of the same type), a single fragment of palm frond, perhaps house thatch, and an abundance of modern seeds (Table 5.7).

<u>Samples from areas with variously aged deposits</u>

Last to be discussed are samples that could not be definitively assigned to a particular cultural complex because of the juxtaposition of features and cultural materials variously attributed to Hacienda Grande, Cuevas, Monserrate, and Santa Elena styles. Carbon Samples 326 through 334 (Tables 5.4 and 5.7) are from the macroblock-house area, but are not necessarily Ostionoid in cultural affiliation. Flotation Samples 311 to 364 (Tables 5.4, 5.7)

are from Mounded Midden 2 that dates from Cuevas to Santa Elena times. Finally, Flotation Sample 588 comes from Midden 3 that has Hacienda Grande, Cuevas, and possibly also Monserrate diagnostics.

The contents of the samples from the various locations noted above are briefly summarized here. Bully-tree and maga wood appear in the macroblock samples, with the former particularly conspicuous (Table 5.7; six out of eight samples from the general macroblock contexts). Seeds are absent from among the macroblock samples, aside from the modern specimens noted above that were recovered from the Ostionoid-aged ditch and house complex (Table 5.7).

The flotation samples from Mounded Midden 2 (samples 311-364 in Table 5.7) did not produce identifiable wood, but two types of carbonized seed are present. Flotation Sample 311 contained the only trianthema seed thus far documented for Maisabel. An unidentified seed or fruit pit was recovered from a slightly deeper (10 cm) level (Flotation Sample 336) of the same excavation unit as the trianthema seed, and an additional specimen (in five fragments) apparently of the same seed type appeared in Sample 351 from near the bottom of the excavation unit (Table 5.7). This seed/pit type is possibly manchioneel (Hippomane mancinella), with its prominent spines eroded or burnt away. Flotation Sample 364 contained a single unidentified seed coat fragment (Table 5.7).

Maisabel summary

Eleven archaeological plant types were identified in samples from Peter Siegel's excavations at Maisabel. Combined, the wood species diversity for Maisabel contexts is low, with no more than two types identified per provenience. The exception is Carbon Sample 253, which produced five different wood types that may be remnants of fuelwood. The limited species diversity characteristic of the remaining samples (all but Sample 364 having a single wood type) is reminiscent of the situation that was documented for the Golden Rock site described in Chapter 4. This suggests that much of the Maisabel wood may be what is left of house posts and building materials. If this is true, then bully-tree seems to have been preferentially used for construction, considering that it is the only wood in over half (56%) of the carbon samples (Table 5.7). Record and Hess (1943:501) report that *Pouteria* sp. timber is suitable for durable construction and that the heartwood is highly resistant to decay. Since individual wood specimens from Maisabel are large and well preserved they may accommodate growth ring analysis of the type carried out with the Golden Rock specimens. This might help to show whether the bully-tree wood served as posts and house supports. The growth rings produced by bully-tree are not as easily discerned as, for example, lignum-vitae from Golden Rock, but this type of analysis is worth an attempt, once the research on Maisabel is resumed.

Bully-tree also was identified from the Calle Cristo site, described above. Calle Cristo is located just east of Maisabel (Figure 5.1) and is at least partially contemporaneous. Bully-tree may have been a homegarden species or otherwise tended tree. Nevertheless, with native Pouteria multiflora relatively abundant in the wild (Loigier and Martorell 1982:136; Little and Wadsworth 1964:452), the specimens from both sites may have existed as components of the natural vegetation.

Other possible protected or housegarden trees provisionally identified from Maisabel include calabash tree (Bignoniaceae; Table 5.6), guaba, guava, and panama-tree (Ninez 1984; Padoch and deJong 1991; Record and Hess 1943:282). These trees have a wide range of economic possibilities. Calabash is grown primarily for its hard-shelled fruit; the inner lining of guaba pods is edible and the wood of at least one native species of Inga sp. is valued for fuel and other purposes (Record and Hess 1943:253); guava fruit, like bully-tree, can be prepared and consumed in a variety of ways; finally, Panama-tree seeds are edible.

Trianthema seeds and greens, palm fruit, and wild figs may also have been food items for the inhabitants of Maisabel, based on the limited evidence for their presence at the site. Thus, all together, eight possible plant foods were recovered from Maisabel. None of these are domesticated plants, but a few, Panama-tree in particular,

may have existed as part of a housegardening system. The tree species were potentially important sources of fresh fruit for food and for medicinal purposes. Aside from their valuable fruit, any of the woods from among the Maisabel deposits may have been used for fuel and for other purposes.

El Fresal, Puerto Rico

El Fresal is an Ostionoid site located in south-central Puerto Rico (Figure 5.1; Meléndez 1988). Ceramics recovered from the site include sherds belonging to the Ostiones and to the Santa Elena complexes, as well as to the later Esperanza, Capa, and Boca Chica styles. Three features that are probable hearths or cooking areas were analyzed for associated plant materials. One of the burned deposits, Feature 3, was dated by the radiocarbon method, producing a date of 790+/-60 B.P. (1160+/-60 A.D. [Beta-26326]; Meléndez 1988).

Data summarizing the archaeobotanical samples from El Fresal are presented in Table 5.8. Wood remains are relatively abundant and well preserved. However, time and funding constraints dictated that the analysis emphasize potential subsistence data. To this end, seeds and soft-tissue fragments were thoroughly investigated, while wood remains were classified by anatomy, but in most cases are not otherwise identified. Nevertheless, 20 fragments of wood per provenience were examined and are classified and/or identified. Seeds were recovered in samples from two of the features. A few of the seed types from El Fresal, along

Table 5.8. Overview of archaeobotanical samples from El Fresal, Puerto Rico. (Seed density-1 is based on the total seed count, including modern seeds; density-2 is based on the presence of archaeological seeds only.)

PROVENIENCE	SAMPLE CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	--SEED-- DENSITY -1	-2
B-49, Feat. 3	hearth/ post	34.00	-	70.15	8.19	0.2	20	6	0	0.2	-
B-91, Feat.38	hearth	20.50	-	25.35	11.00	0.5	20	22	2	1.1	0.1
B-69,Fea.18 south	hearth	42.00	58.28	43.85	15.84	0.4		128	60	3.0	1.4
B-68,Fea.18 north	"	28.50	31.00	23.48	5.96	0.2		736	299	26.0	10.5
B-70,Fea.18 north	"	26.00	-	62.83	26.60	1.0	20	205	97	8.0	4.0
Fea.18 COMBINED	"	96.50		130.16	48.40	0.5		1069	456	11.1	5.0
TOTALS:		151.00		225.66	67.59		60	1097	458		

with indirect evidence from certain of the wood identifications described below, may be interpreted as possible subsistence items.

Plant identifications from the three El Fresal features are shown in Table 5.9. Plants grouped as archaeological types include at least 19 different types. A diverse assemblage of modern seeds was recovered with the samples; none of these seeds occurs also in carbonized form. Archaeological seeds include goosefoot family (Chenopodiaceae), stargrass (Hypoxis sp.), evening primrose (Oenothera sp.), maypop (Passiflora sp.), and wild raspberry (Rubus sp.). Three of these are problematical, to varying degrees. The single maypop (Passiflora sp.) seed is possibly mineralized and may be older than the seeds classified as modern. However, unless and until additional evidence is gathered, including the recovery of more maypop specimens, the seed may be better grouped with the modern seed types.

Similarly, the raspberry seeds seem to have been preserved in the deposits through mineralization, but it is difficult to say whether they are truely contemporaneous with prehistoric activities at the site. The situation with this type of seed (raspberry), given that it possesses a hard, boney seed coat, is basically the same as that described for the cockspur (Celtis sp.) seeds from the Lesser Antilles sites described in Chapter 4. Likewise, conditions (i.e., the clayey, in this case, deposits and the

Table 5.9. Plant identifications from El Fresal, Puerto Rico.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Chenopodiaceae	goosefoot family	seed
cf. _Ficus_ sp.	fig (jagüey)	wood
Hypoxis sp.	yellow stargrass (coquí)	seed
Oenothera sp.	evening primrose	seed
Passiflora sp.*	maypop (parcha)	seed
Rubus sp.	raspberry (rosa minadora)	seed
Sapotaceae cf. _Pouteria_	bully-tree (jácana)	wood
cf. Sapotaceae	sapote family	wood
Uniden. wood-type 1	wide rays, pore density low	wood
Uniden. wood-type 2	vasicen.-confluent parench., rays strongly heterocellular	wood
Uniden. wood-type 3	pore density high, parenchyma sparse	wood
Uniden. wood-type 4	wide rays, confluent parenchyma	wood
Uniden. wood-type 5	parenchyma diffuse-in-aggreg.	wood
Uniden. wood-type 6	pores solitary, density high, parenchyma weakly paratrach.	wood
Uniden. wood-type 7	pores small-diam., frequent	wood
Uniden. wood-type 8	wide rays, reticulate parenchyma	wood
Uniden. wood-type 9	pores med.-large, radial ser. of 2-4, paren. paratracheal in wide bands, rays narrow	wood
Uniden. wood-type 10	pores medium diam., solitary, paren. diffuse-in-aggregates	wood
Uniden. wood-type 11	pore diam. small, wide rays	wood
Uniden. seed fragment	small, carbonized	seed
Uniden. dicotyledonous	small herb	stem
Modern seeds:		
Asteraceae	sunflower family	seed
cf. _Atriplex_ sp.	atriplex (garbancillo)	seed
Capsicum sp.	chili pepper (pimiento)	seed
cf. _Cerastium_ sp.	chickweed	seed
Cyperaceae, type 1	sedge family	seed
Cyperaceae, type 2	sedge family	seed
Cyperaceae, type 3	sedge family	seed
Eleusine _indica_	goosegrass (grama de caballo)	seed
Euphorbia sp.	spurge (maravilla)	seed
Fabaceae, cf. _Cassia_	bean family	seed
Malvaceae, cf. _Sida_	broomweed (escoba)	seed

Table 5.9--continued.

TAXON	COMMON NAME	PLANT PART
Oxalis sp.	sorrel (trebolillo)	seed
Poaceae, indeterminate	grass family	seed
Poaceae cf. _Bouteloua_	mesquite-grass (yerba mesquite)	seed
Poaceae cf. _Cynodon_ sp.	bermuda grass (pepe ortiz)	seed
Poaceae cf. _Paspalum_	grass	seed
Poaceae, Panicoid	millet grass (arrocillo)	seed
Portulaca sp.	purslane (verdolaga)	seed
Solanaceae cf. _Physalis_	ground cherry (alquequenje)	seed
Solanaceae cf. _Solanum_	nightshade (yerba mora)	seed

* seed may be modern.

Wood identification was not the focus of this analysis. Thus, several types have undergone preliminary descriptive analysis, but have not been further identified.

chemistry/structure of the seed coats) are favorable for preservation by means other than by carbonization. Thus, for the time being, the raspberry seeds from El Fresal are grouped among the specimens whose presence is attributed to the prehistoric occupation at El Fresal. Native raspberries (Rubus spp.) grow in mountainous areas of Puerto Rico (Liogier and Martorell 1982:56). Note also that one primrose seed from El Fresal is apparently mineralized, rather than carbonized.

Finally, the third potentially problematic identification is stargrass. Stargrass is a common Caribbean weed (Liogier and Martorell 1982:231). As such and because the seeds are very small (ca. 1 mm diameter) stargrass seeds could readily have blown or fallin into the site deposits. Thus the association of carbonized stargrass seeds with the archaeological deposits should be considered provisional until there is additional verification of stargrass's presence in prehistoric deposits. (Nevertheless, there is another site on Puerto Rico from which carbonized stargrass seeds were recovered: see below.)

Oenothera sp. from El Fresal is the same type of seed as was described in Chapter 4 from Ortoiroid Hichmans' Shell Heap on Nevis. Carbonized El Fresal seeds (n = 5) average 1.52 mm length (range 1.15-1.75) and 0.26 mm in width (range 0.60-0.90 mm) To reiterate from Chapter 4, the present range of the genus Oenothera does not include the Caribbean islands, except for Cuba. Thus, the El Fresal site provides

site provides a second record for the appearance of Oenothera sp. in a prehistoric archaeobotanical assemblage, and additional verification of a previously more extensive range for the genus. When and under what conditions Oenothera's range began to shrink has not been investigated.

The goosefoot-family seed identification, the last of the types mentioned above, also requires some clarification. Chenopodium sp. is an important and well-known genus throughout American archaeobotany (Pickersgill 1989; Smith 1992; Watson 1989; Wilson and Heiser 1979). However, by general morphology the Chenopodiaceae seeds from El Fresal appear to belong to another member of the family, rather than Chenopodium sp. (The groove extending from the hylar notch to near the center of the seed coat is too weakly defined for Chenopodium sp. [Martin and Barkley 1969:151-152].) Moreover, very similar, if not the same type of seed was recovered from Barrio Ballajá in San Juan (discussed below); the seed embryos are preserved in many of the specimens from Ballajá so that embryo morphology and position are discernable. The Ballajá seed embryos are spirally coiled and completely fill the seed cavity, precluding the genus Chenopodium sp. by its curved embryo that does not fill the seed coats (Martin and Barkley 1969:151-152). The El Fresal and Ballajá seeds are similar enough to suggest they are from the same genus or species. Chenopodiaceae seeds from both sites conform well with the genus Suaeda sp. (seablite), but this genus is not listed as

part of Puerto Rico's flora. The seeds may still belong to Suaeda sp., paralleling the situation with primrose of a once more extensive geographic distribution, but other genera need to be considered. For the present purposes, and in lieu of suitable comparative specimens with which to compare other genera, the seeds from both sites are classified to the family Chenopodiaceae.

Three types of wood are identified from the El Fresal features; 11 others have been classified by their anatomy, but not further identified. Present among the samples is a wood belonging to the sapota family (Sapotaceae) that conforms closely with bully-tree (Pouteria sp.). This wood is very similar or the same as the wood specimens that were recovered from the Calle Cristo and Maisabel sites. A second type of Sapotaceae wood may also be present (cf. Sapotaceae, Table 5.9). Native wild fig (Ficus sp.) is provisionally identified among the wood remains, also mirroring the Maisabel site.

Plant identifications from El Fresal are listed by their respective proveniences in Table 5.10. Feature 3 is the most diverse of the three contexts studied in terms of wood, with 11 plant types recorded. Seeds, however, are absent. An unidentified fragment of woody-annual (herb) stem that may have served as tinder is present also in Feature 3 (Table 5.10). Feature 38 produced six types of wood and a single identifiable (stargrass) seed. In contrast to the first two features, seeds are a conspicuous

Table 5.10. Plant identifications from El Fresal features (by count).

IDENTIFICATION:	Feat.3	Feat.38	-----Feature 18------ #B-69	#B-68	#B-70	Feat.18 TOTAL	PLANT TOTAL	RELATIVE FREQ.+
CULTIVATED:								
Primrose*			1	5		6	6	.01
WILD EDIBLE:								
Bully-tree	1						1	
cf. Fig	1				2	2	3	
Goosefoot family			1	2	1	4	4	<.01
Maypop*				1		1	1	<.01
Raspberry			14	59	21	94	94	.20
OTHER:								
cf. Sapotaceae	1						1	
Yellow stargrass		1	44	231	73	348	349	.76
Unid. wood-type 1	1						1	
Unid. wood-type 2	6	3			16	16	25	
Unid. wood-type 3	3	1					4	
Unid. wood-type 4	2				2	2	4	
Unid. wood-type 5	1						1	
Unid. wood-type 6	2	6					8	
Unid. wood-type 7	1						1	
Unid. wood-type 8	1						1	
Unid. wood-type 9		1					1	
Unid. wood-type 10		7					7	
Unid. wood-type 11		2					2	
Seed/fruit frag.		1		1	2	3	4	<.01
Unid. soft tissue	31	49	31	6	18	53	133	
Unid. herb stem	1		7		3	10	11	
MODERN SEEDS:								
cf. atriplex				1	1	2	2	
broomweed				3	2	5	5	
cf. chickweed	1				1	1	2	
chili pepper			1			1	1	

Table 5.10--continued.

IDENTIFICATION:	Feat.3	Feat.38	------Feature 18-----			Feat.18	PLANT	RELATIVE
			#B-69	#B-68	#B-70	TOTAL	TOTAL	FREQ.+
goosegrass			18	77	17	112	112	
grass fam., indet.				10	3	13	13	
grass cf. bermuda			17	120	27	164	164	
grass cf. mesquite	2						2	
grass, Panicoid			2	4	3	9	9	
grass cf. Paspalum			1		7	8	8	
ground cherry			5	8	5	18	18	
nightshade			5	4	2	11	11	
purslane			1	5	3	9	9	
sedge type 1				11	9	20	20	
sedge type 2				21	5	26	26	
sedge type 3				14		14	14	
sorrel		1	18	80	11	109	110	
spurge				12	2	14	14	
sunflower family	3	18		29	4	33	54	
wild legume				9		9	9	
unid. seed		1		29	6	35	36	
TOTAL NO.								
WOOD TYPES:	11	6	-	-	3	3		
SEED TOTAL:	6	22	128	736	205	1069		
ARCHAEO. SEEDS:	0	2	60	299	97	456		

*Primrose is listed as a cultivated plant because of its possible role as a tended, housegarden species (see text). Maypop may be modern, intrusive.
+Relative frequency is based on the archaeological seed assemblage only. Taxon ubiquity is not reported because so few samples from El Fresal have undergone analysis.

component of Feature 18, totalling more than 1000 specimens (Table 5.10). Three types of wood also were recovered with Feature 18.

Feature 18 is large (96.50 liters of fill were recovered and floated) and may have functioned as a hearth or communal fire. Most of the seeds from the feature, including 299 probable archaeological specimens, were concentrated in Sample B-68 from the northern half of the feature (Table 5.10). The total number of seeds from Feature 18 that are at least tentatively associated with the prehistoric occupation of the site is 456. These include Oenothera, goosefoot family, raspberry, and stargrass, keeping in mind the caveats concerning the latter two. The possibly mineralized maypop seed also came from Feature 18. Carbonized stargrass seeds are very numerous (349 total; 76% of the feature total), particularly in Sample B-68 from the northern portion of the feature (Table 5.10). Raspberry seeds are the second most frequent type (20% of the feature total), followed by Oenothera (6 specimens, 1% of the total), and the goosefoot-type seed.

Three types of wood were recovered from Feature 18, including the tentatively identified fig, and 16 fragments (64% of the total) of the type-2 wood, which also was identified from among the fill of the other two hearth deposits (Table 5.10). The fig-type wood also was recovered from Feature 3, and this feature is the only context from which bully-tree was identified (Table 5.10). The

relatively high number of wood types in Feature 3 and in Feature 38 (11 and 6 types, respectively [Table 5.10]), is consistent with the the features having functioned as hearths.

In combination, six identifications from El Fresal could represent plant foods, including bully-tree, Oenothera sp., wild fig, goosefoot family, maypop, and raspberry. Two of these identifications--bully-tree and Oenothera--corroborate evidence for plant utilization from other sites, as was noted above. Oenothera was described in Chapter 4; virtually the entire plant is edible. The same is basically true of most Chenopodiaceae, including seablite (Suaeda spp.). Potential sources of fresh edible fruit from the El Fresal samples include raspberry, maypop, native figs, and bully-tree. I am unaware of any reported economic value for stargrass.

Finally, in a preliminary report on El Fresal (Newsom 1988), I described a carbonized fragment of parenchymatous tissue that morphologically resembles a maize (Zea maize) cupule. Since the first report, the plant specimen was examined in greater detail and shown to a specialist on maize (Dr. Margaret Scarry); we concluded that the fragment is not from a maize cob.

El Parking Site (PO-38), Puerto Rico

El Parking site (PO-38) is located in the Cerrillos River Valley in south-central Puerto Rico near Ponce. Ceramics and carbon-14 dates associate the occupation of the

site with Cuevas and Ostionoid (early Ostiones complex) people (Weaver 1992:3-5).

Thirty-five flotation samples from El Parking site were analyzed for archaeobotanical data (Table 5.11), and seed recovery was generally low. So few seeds (9 total) is possibly, but not certainly, a function of the relatively small sample sizes (typically 1-4 liters; Table 5.11). Wood remains likewise were few and generally too small for identification. One exception is a sample from Unit 2-Feature 1 that contained approximately 7 grams of wood (57 specimens identified) (Table 5.11).

Plant identifications from El Parking site are shown in Table 5.12. At least five types of wood were recovered. One wood is identified to genus--acacia (<u>Acacia</u> sp.)--and another to the sapota family (Sapotaceae). Three additional wood types are described by anatomy, but not further identified due to insufficient specimens, each being represented by a single, small fragment of wood.

Seed identifications from El Parking site include Chenopodiaceae, stargrass (<u>Hypoxis</u> sp.), and evening primrose (<u>Oenothera</u> sp.), the same as were described from El Fresal. The single <u>Oenothera</u> seed measures 2.20 mm long by 1.05 mm at its widest point; it is preserved in mineralized form. Feature 1, which contained the <u>Oenothera</u> seed, has a radiocarbon date of cal A.D. 1223+-60 (cal 727+-60 B.P. [Beta-33259], Weaver 1992), similar to the date of A.D. 1160+-60 (709+-60 B.P. [Beta-26326], Meléndez 1988) for El

Table 5.11. Archaeobotanical samples from El Parking Site (PO-38), Cerrillos River Valley, Puerto Rico. (Sample from Unit 30, Feature 52 is light fraction only.)

PROVENIENCE	CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	SEED DEN-SITY
Unit 01, level 01	general	1.00	(trace)	-	-	-	-	1	1	1.0
Unit 01, level 02	general	1.00	(trace)	-	-	-	-	0	0	-
Unit 02, Feat. 01	feature	6.00	7.03	7.03	7.03	1.2	57	2	2	0.3
Unit 02, level 04	general	1.00	(trace)	-	-	-	-	0	0	-
Unit 03, Feat. 04	feature	1.00	(trace)	-	-	-	-	0	0	-
Unit 03, lvls. 1-6	general	9.00	(trace)	-	-	-	-	0	0	-
Unit 04, lvls. 1-4	general	4.00	(trace)	-	-	-	-	0	0	-
Unit 05, lvls. 1-5	general	5.00	(trace)	-	-	-	-	0	0	-
Unit 06, lvls. 1-4	general	4.00	(trace)	-	-	-	-	0	0	-
Unit 07, Feat. 06	feature	5.00	(trace)	-	(trace)	-	4	0	0	-
Unit 08, lvls. 1-7	general	7.00	(trace)	-	-	-	-	0	0	-
Unit 09, lvls. 1-3	general	3.00	(trace)	-	-	-	-	0	0	-
Unit 11, lvls. 1-2	general	2.00	(trace)	-	-	-	-	0	0	-
Unit 13, Feat. 17	pit	4.00	8.50	0.87	7.63	1.9	3	2	2	0.5
Unit 13, Feat. 47	pit	4.00	0.58	0.58	-	-	-	0	0	-
Unit 13, Feat. 48	hearth	4.00	0.24	0.24	-	-	-	0	0	-
Unit 15, Feat. 12	hearth	4.00	0.15	0.15	-	-	-	0	0	-
Unit 17, Feat. 14	post/pit	4.00	0.11	0.11	-	-	-	0	0	-
Unit 18, Feat. 45	hearth	4.00	0.23	0.23	-	-	-	0	0	-
Unit 18, Feat. 46	hearth	4.00	0.16	0.16	-	-	-	0	0	-
Unit 19, Feat. 15	hearth	4.00	0.07	0.07	(trace)	-	1	0	0	-
Unit 19, Feat. 20	postmold	4.00	0.07	0.07	-	-	-	1	1	0.2
Unit 20, Feat. 53	post	4.00	0.25	0.25	-	-	-	0	0	-
Unit 20, Feat. 55	post/pit	4.00	0.47	0.47	(trace)	-	-	0	0	-
Unit 20, Feat. 56	post/pit	4.00	0.22	0.22	-	-	-	0	0	-
Unit 21, Feat. 60	pit	4.00	0.11	0.11	-	-	-	0	0	-
Unit 24, Feat. 40	post/pit	4.00	3.66	1.25	2.41	0.6	0	0	0	-

Table 5.11--continued.

PROVENIENCE	CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	SEED DEN-SITY
Unit 25, Feat. 42	pit	4.00	0.53	0.53	-	-	-	0	0	-
Unit 26, Feat. 27	post/pit	4.00	0.11	0.11	-	-	-	1	1	0.2
Unit 29, Feat. 33	post/pit	4.00	0.28	0.28	-	-	-	0	0	-
Unit 29, Feat. 34	post	4.00	0.09	0.09	0.18	<0.1	2	1	1	0.2
Unit 29, Feat. 35	post	4.00	0.45	0.15	0.30	0.1	0	1	1	0.2
Unit 30, Feat. 52	post/pit	4.00	0.48	0.48	-	-	-	0	0	-
Unit 32, Feat. 11	hearth	4.00	0.05	0.05	-	-	-	0	0	-
Trench 5 Feat. 07	feature	2.00	(trace)	-	-	-	-	0	0	-
TOTALS:		84.00	23.84	13.50	17.55		67	9	9	

Table 5.12. Plant identifications from El Parking Site (PO-38), Cerrillos River Valley, Puerto Rico.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
<u>Acacia</u> cf. <u>A</u>. <u>farnesia</u>	acacia (aroma, zarza brava)	wood
<u>Carica</u> <u>papaya</u> (wild)*	papaya (pawpaw, lechosa)	seed
Chenopodiaceae	goosefoot family	seed
cf. <u>Cleome</u> sp.	spider flower	seed
<u>Hypoxis</u> sp.	yellow stargrass (coquí)	seed
<u>Oenothera</u> sp.	evening primrose	seed
Sapotaceae	sapote family	wood
Uniden. wood-type 1	Cerrillos-1, sp.gr. ca. 0.6; vessels medium-sized, moderate distribution, pairs frequent; axial parenchyma sparce and in short tangential series; rays close, 1-2 seriate, heterocellular	wood
Uniden. wood-type 2	Cerrillos-2, vessels medium-large, solitary, evenly distributed; ax. parenchyma in diffuse-in-aggregate and, less often, 2-3 seriate bands, apotracheal, but occasionally intersecting pores; rays heterocellular, cells fine, 1(2) seriate	wood
Uniden. wood-type 3	Cerrillos-3, dense wood (sp.g. >0.7); pores large, tyloses abundant; paratracheal parenchyma; rays 1-2 seriate	wood
Unidentified hardwood		wood

*native of continental tropical America (Liogier and Martorell 1982:115)

Fresal features containing Oenothera. A single seed that is provisionally identified as spider flower (Cleome sp.), and, very significantly, a papaya (Carica papaya) seed are also identified from the El Parking site. The genus Carica derives from Central America (Rehm and Espig 1991; Liogier and Martorell 1982; cf. Prance [1984:92] who states that papaya is of Andean origin). Exactly when C. papaya (papaya) first arrived in the Caribbean is not known; there are no endemic Carica species listed for the region. Oviedo y Valdes (1959; in Prance 1984) believed that papaya did not occur in the Caribbean islands prior to European colonization, but papaya's presence in Ceramic Age deposits from El Parking Site demonstrates otherwise. Feature 34 from which was recovered the El Parking Site papaya seed has a radiocarbon date of 1280+-80 years B.P. (Beta-45292) (cal A.D. 656-855) (Weaver 1992).

Wild papaya seeds are relatively small, as demonstrated by a representative accession of wild (possibly feral) papaya from the Florida Museum of Natural History collections (Table 5.13). Morphometric data from domesticated papaya seeds overlap those of wild papaya, but have a broader range. Seeds from three accessions of domesticated papaya average 7.34 mm, 5.58 mm, and 5.11 mm long, by 4.83 mm, 3.87 mm, and 3.50 mm wide, respectively (Table 5.13). The papaya seed from El Parking Site is smaller than seeds of either the wild or domesticated forms in the seed comparative collection (Table 5.13; Figure 5.2),

Table 5.13. Carica papaya seed measurement (mm) statistics from modern assessions. (n = 30 seeds per accession; Cultivars 1-3 and the Mosquito Lagoon papaya each are represented by a single individual fruit; W/L = width to length ratio.)

	CULTIVAR #1:			CULTIVAR #2:			CULTIVAR #3:		
	Length	Width	W/L	Length	Width	W/L	Length	Width	W/L
Mean	7.34	4.83	0.66	5.58	3.87	2.28	5.11	3.50	0.69
Stan.dev.	0.35	0.26	0.04	0.25	0.22	0.04	0.29	0.18	0.04
Minimum	6.67	4.36	0.59	5.06	3.49	0.62	4.40	2.92	0.61
Maximum	8.23	5.37	0.76	6.16	4.56	0.82	5.64	3.81	0.78
Coeff.var.	4.80	5.30	6.23	4.45	5.72	1.93	5.64	5.12	6.18

	WILD (?) FERAL FORM: Mosquito Lagoon, Florida			COMBINED VALUES, CULTIVARS 1-3:		
	Length	Width	W/L	Length	Width	W/L
Mean	4.82	2.99	0.62	6.01	4.07	0.68
Stan.dev.	0.21	0.15	0.03	1.01	0.60	0.05
Minimum	4.32	2.58	0.53	16.76	14.77	6.67
Maximum	5.38	3.32	0.70			
Coeff.var.	4.27	5.19	5.28			

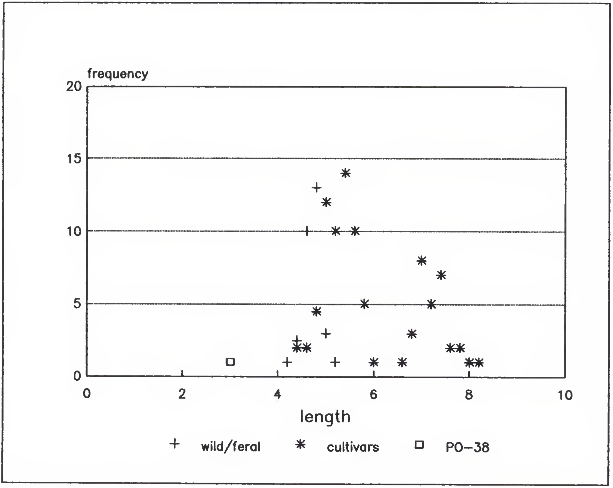


Figure 5.2. Papaya (Carica papaya) seed dimensions (in millimeters).

being 3.05 mm long by 2.26 mm wide. Adjusting upward by 4% to take into account shrinkage from carbonization gives revised measurements for the El Parking seed of 3.17 mm for length and 2.35 mm for width (the 4% estimate was calculated after carbonizing 30 seeds from cultivar no. 3 [Table 5.13] and measuring the dimensional change). The adjusted dimensions are still smaller than measurements from any of the museum accessions, at probable indication that the El Parking Site seed represents a wild form of papaya. There is nothing to suggest that the El Parking Site seed is immature and correspondingly undersized.

Seed coat texture is another feature that distinguishes wild from domesticated forms of papaya. Seeds of domesticated papaya are deeply furrowed and have abundant, salient spines. In contrast, wild papaya seed coats have shallow furrows, and the spines are lacking or weakly developed. The El Parking Site seed, in addition to its small size, conforms with wild papaya by its relatively smooth, shallowly furrowed seed coat that lacks spines.

The distributions of the archaeobotanical plant types are listed by provenience in Table 5.14. The papaya seed was recovered from Feature 34, along with Sapotaceae wood and an unidentified type of wood (Cerrillos-3). <u>Oenothera</u>, another possible plant introduction, occurs in Feature 1, in addition to the single cf. spider flower seed and abundant acacia wood. Otherwise, acacia wood occurs in Feature 6. The goosefoot-family seed was recovered with Feature 7,

Table 5.14. Plant identifications from El Parking Site (PO-38)* (by count).

IDENTIFICATION:	U.1 Lv. 1	U.2 Fe. 1	U.3 Lv. 5	U.7 Fe. 6	U.13 Fe. 7	U.19 Fe. 15	U.19 Fe. 20	U.20 Fe. 55	U.24 Fe. 40	U.26 Fe. 27	U.29 Fe. 34	U.29 Fe. 35	PLANT TOTAL	UBIQUITY
CULTIVATED:														
Papaya											1		1	8
Primrose+		1											1	8
WILD EDIBLE:														
Goosefoot					2							1	3	16
OTHER:														
Acacia		57		4									61	16
Sapotaceae					1	1					1		3	25
cf. Spider flower		1											1	8
Stargrass							1			1			2	16
Cerrillos-1					1								1	8
Cerrillos-2					1								1	8
Cerrillos-3											1		1	8
Ud. hardwood						3		1	1			1		
Unid. seed/ fruit	1												1	8
Unid. soft tissue			3											
TOTAL NO. WOOD TYPES:	0	1	0	1	3	4	0	1	1	0	2	1		
SEED TOTAL:	1	2	0	0	2	0	1	0	0	1	1	1		
ARCH. SEEDS:	1	2	0	0	2	0	1	0	0	1	1	1		

*Samples with no identifiable remains are excluded here; see Table 5.11.
+Primrose is listed as a cultivated plant because of its possible role as tended, housegarden species (see text).

along with Sapotaceae wood and Cerrillos wood types 1 and 2. Sapotaceae wood is the most ubiquitous type, occurring in three proveniences (25% ubiquity; Table 5.14).

Barrio Ballajá, San Juan, Puerto Rico

Excavations in historic Barrio Ballajá of nineteenth-century dwellings and one institutional complex (see Chapter 3) produced a wealth of preserved plant material. A complete discussion of the archaeobotanical analysis of Ballajá deposits is beyond the scope of this thesis, given the late age and that the deposits were produced by people of ethnic origins besides Caribbean Indians. Full details of the Ballajá analysis are presented Newsom 1992b. Nevertheless, certain of the Ballajá identifications are pertinent to the prehistoric sites and to a general understanding the ethnobotany of the island. If anything, the Ballajá study and similar analyses of post-contact material extend into the historic period our perspective on plant use in the Caribbean islands. Moreover, the research provides another context, ethnobotany, with which to interpret cultural dynamics in and between the pre- and post-contact eras.

Results of the Ballajá archaeobotanical analysis are briefly summarized below. Plant identifications that help to elucidate the general reconstruction of Taino plant use are discussed in more detail.

An overview of the types of Ballajá contexts that underwent archaeobotanical analysis is presented in Table

5.15. Most of the samples represent household refuse. Greater detail for the flotation samples, from which most of the data were recovered, is provided in Table 5.16. Ethnobotanical research on Barrio Ballajá was directed toward dietary and general subsistence data. Hence, the analyses of the variously aged sites and components emphasized seeds and other non-wood remains. Wood identification was limited to a search for imported species associated with the lumber industry (see Newsom 1992b); otherwise wood identification was reserved for future study.

Preservation of Ballajá contexts is exceptional. Many specimens exist in semi-waterlogged or mineralized form; other plant remains are carbonized (Newsom 1992b). Seeds are relatively abundant, including 459 archaeological specimens (Table 5.16). The complete list of Ballajá plant identifications is shown in Table 5.17. The frequencies and distributions of the various taxa are shown in Table 5.18. Values in parentheses in Table 5.18 are tentative identifications, and those marked by "x" signify present, but not individually counted. Asterisked samples in Table 5.18 represent miscellaneous collections of plant materials from 1/4-1/16" excavation screens and/or specimens encountered and isolated in the course of laboratory operations in San Juan.

Several domesticated and/or important garden and orchard species are identified among the Ballajá samples (Table 5.17). Noteworthy is the presence of plant staples

Table 5.15. Barrio Ballajá: samples analyzed for plant remains.

Area/Provience	Sample context	Sample number	Flot. number/ fraction
1 Area Norte Fea. 18	house refuse	249	054/light
1 Fea.35 Strat.III 107-185cm	house refuse	518	120/light
1 Fea.35 level 5 185-197cm	house refuse	531	123/light
1 Fea.48 Strat. I 113-161cm	house refuse	592	131/light
1 Fea.48 Strat.II 113-166cm	house refuse	604	132/light
3 N127/E107 Strat.I 20-40cm	house refuse	339	080/light
3 Fea.25 Strat. I	latrine	405	096/light
3 Fea.25 Strat. III	"	417	101/light
3 Fea.25 Strat. III	"	412	- /screen
3 Fea.25 Strat. III	"	624	138/heavy
3 Fea.25 Strat. IV	"	413	- /screen
3 Fea.25 Strat. IV	"	413	- /lab
3 Fea.25 Strat. IV	"	414	099/light
3 Fea.25 Strat. IV	"	416	100/light
3 Fea.37 Strat. II 63-83 cm	house refuse	564	- /lab
3 Fea.38 Strat. II	house refuse	528	122/lab
3 Fea.57 Strat. III	hospital dump	621	- /lab
3 Fea.57 Strat. III	"	621	- /carbon
3 Fea.57 Strat. III	"	621	- /screen
3 Fea.57 Strat. III	"	622	136/light
4 Unit 1 Strat. III	house refuse	743	- /lab
5 Fea.82 Strat. II 86-111cm	house refuse	968	182/light
5 Fea.94 Strat. III	house refuse	1056	198/light
5 Fea.94 Strat. VI	house refuse	1068	198/light

Notes: Light and heavy fractions refer to the two sample components that result from sample preparation by water flotation. Samples designated "screen" are plant remains extracted from 1/4"-1/16" screened faunal samples during zooarchaeological analysis at Florida Museum of Natural History; carbon sample N.C.621 is 1/4"-screened material. Samples designated "lab" are individual specimens that were forwarded to the FlaMNH as they were encountered during laboratory operations in San Juan.

Table 5.16. Overview of flotation samples from Barrio Ballajá. (Seed density-1 is based on the total seed count, including modern intrusive seeds; Density-2 is based on the presence of archaeological seeds only.)

AREA	PROVENIENCE	SAMP. NO.	FLOT. NO.	SAMPLE VOLUME (ltrs.)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	----SEED---- DENSITY -1	-2
1	Feat.18	249	54	0.25	80.74	77.57	3	5	3	20.0	12.0
1	Feat.35 Stra.III	518	120	0.10	35.82	35.80		2	0	20.0	-
1	Feat.35 Lv.5	531	123	0.07	21.00	20.85		4	4	57.1	57.1
1	Feat.48 Stra.I	592	131	0.23	69.05	63.61		118	108	513.0	469.6
1	Feat.48 Stra.II	604	132	0.13	40.80	40.80	1	132	128	1015.4	984.6
3	N127/E107 Lv.20-40	339	80	0.07	19.99	18.38		0	0	-	-
3	Feat.25 Stra.I	405	96	1.50	512.95	512.95		19	19	12.7	12.7
3	Feat.25 Stra.III	417	101	0.04	7.44	6.71		124	124	3100.0	3100.0
3	Feat.25 Stra.IV	414	99	0.05	19.76	15.73		0	0	-	-
3	Feat.25 Stra.IV	416	100	0.05	13.38	12.85		13	12	260.0	240.0
3	Feat.57 Stra.III	622	136	0.60	370.00	11.71	8	47	46	78.3	76.7
5	Feat.82 Stra.II	968	182	0.13	38.00	33.58		1	0	7.7	-
5	Feat.94 Stra.III	1056	198	0.50	190.76	190.76		2	1	4.0	2.0
5	Feat.94 Stra.VI	1068	198	0.20	63.58	61.61	2	16	14	80.0	70.0
TOTALS:				3.91	1483.27	1102.91	14	483	459		

Table 5.17. Plant identifications from Barrio Ballajá, historic San Juan, Puerto Rico.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Annona sp., cf. A. muricata+	soursop (guanábana, anón)	seed
cf. Cactaceae, (Opuntia sp.)	prickly-pear (tuna)	pad/fruit
Capsicum sp.+	chili pepper (pimiento)	seed
Carica papaya+	papaya (pawpaw, lechosa)	seed
Chenopodiaceae	goosefoot family	seed
Citrus sp.*	orange/grapefruit (toronja)	seed
cf. Cocos nucifera	coconut (cocotero)	shell
Ficus sp. cf. F. carica*	fig (higuera)	seed
cf. Fraxinus sp.* +	ring-porous hardwood (ash)	wood
Quercus sp.* +	white oak group	wood
Lycopersicon lycopercicum+	tomato (tomate)	seed
cf. Mastichodendron sp.	mastic (tortugo amarillo)	seed
cf. Palmae	palm family	seed
Palmae	palm family	wood
Physalis sp.	ground cherry (alquequenje)	seed
Picea sp.* +	spruce	wood
Pinus sp.* +	hard group pine	wood
Poaceae, Panicoid grass	millet grass (arrocillo)	seed
Rubus sp.	raspberry (rosa minadora)	seed
Vitis (vinifera)*	European wine grape (parra)	seed
cf. Zea mays+	?maize cob (maiz)	cob
Unidentified-type 1	spherical, <1mm diam.	seed
Unidentified-type 2	flat, round, 1 mm diam.	seed
Unidentified-type 3	cone-shaped, ca. 3 mm long	seed
Unidentified-type 4	cf. Atriplex (garbancillo)	seed
Unidentified-type 5	Cyperaceae/Poaceae	seed
Modern seeds:		
Leguminosae	bean family, wild	seed
Malvaceae, Malva/Sida	mallow family (escoba)	seed
Oxalis sp.	sorrel (vinagrillo)	seed
Poaceae, indeterminate	grasses, several types	seed
Portulaca sp.	purslane (verdolaga)	seed
Sabal sp.	hat palm, cabbage palm	seed
Unidentified-type 6	dry,5-lobed, 11 mm length	seed
Unidentified-type 7	?Meliaceae/?Leguminosae	seed

+New World exotic; some are prehistoric introductions into the Caribbean, e.g., papaya. *Old World origin; some have natural distributions [* +] spanning both hemispheres.

Table 5.18. Plant identifications from Barrio Ballajá (by count; ( ) = tentative).

IDENTIFI-CATION:	BALLAJA-1: Fea.18	----Fea.35---		---Fea.48----		BALLAJA-3: --------------Fea.25--------------				
	Fl.54	Fl.120	Fl.123	Fl.131	Fl.132	Fl.96	Fl.101	Fl.99	Fl.100	N.C.413
CULTIVATED:										
Chili pepper					1					
Citrus sp.										1
Coconut										
Fig			1	97	15		112		9	
Grape	(1)			(1)	9					
Maize								(1)		
Papaya	1		1	5	23	19	12		2	
Soursop			1							
Tomato			(1)		43					
OTHER:										
Raspberry				1	6					
cf. Cactus										
cf. Mastic				1						
cf. Palm				2	3					
Goosefoot										
Panicoid grass				1	3					
Ground cherry					5				1	
Unid. ##1-5	1				20					
Ud. seed/fruit					4					
Ud.soft tissue	12	4	0	2	24		12			
MODERN SEEDS:										
Grass, indet.	2	1		10						
Mallow family										
Oxalis sp.		1								
Portulaca sp.									1	
Sabal sp.										
Wild bean										
SEED TOTAL:	5	2	4	118	132	19	124	0	13	1
ARCH. SEEDS:	3	0	4	108	128	19	124	0	12	1

Table 5.18--continued.

IDENTIFI-	Ballaja-3, continued.					BAL.-4	BALLAJA-5:				
CATION:	Fea.37	Fea.38	----Fea.57---		127/107	Unit 1	Feat.82	---Fea.94--		PLANT	UBI-
	N.C.564	N.C.528	Fl.136	NC.621	Fl.80	NC.743	Fl.182	Str.3	Str.6	TOTAL	QUITY
CULTIVATED:											
Chili pepper									1	2	18
Citrus sp.										1	9
Coconut				(2)						2	9
Fig			9						(1)	244	45
Grape										11	18
maize										1	9
Papaya									7	70	45
Soursop		1		1						3	27
Tomato									(2)	46	27
OTHER:											
Raspberry								1	1	9	18
cf. Cactus				(8)						8	9
cf. Mastic										1	9
cf. Palm										5	9
Goosefoot			28							28	9
Panicoid grass			1							5	18
Ground cherry									1	7	27
Unid. ##1-5			8								
Ud. seed/fruit									1	4	
Ud.soft tissue			7	93			50	28	14	246	
MODERN SEEDS:											
Grass, indet.									1	14	36
Mallow family							1	1	1	3	18
Oxalis sp.										1	9
Portulaca sp.										1	9
Sabal sp.						1				1	9
Wild bean			1							1	9
SEED TOTAL:	1	1	47	4	0	1	1	2	16		
ARCH. SEEDS:	0	1	46	1	0	0	0	1	14		

and fruit trees, including soursop (Annona sp.), papaya (Carica papaya), citrus (Citrus sp.), fig (Ficus sp., probably F. carica), tomato (Lycopersicon lycopercicum), European grape (Vitis vinifera), and possibly also maize (Zea mays). Pepper/pimiento seeds (Capsicum annuum-chinense-frutescens complex) also were recovered. Citrus, the fig, and European grape are Old World plants that would not have been available to prehistoric people in Puerto Rico and will not be further discussed here (see Newsom 1992b for more detail).

The native American garden plants--soursop, pepper, papaya, tomato, and maize (the latter is a tentative identification)--are important identifications in terms of the developing understanding of plant use in the Caribbean and particularly in Puerto Rico. Currently, lacking confirmation of their presence at prehistoric sites, the Ballaja identifications represent the first and earliest record for the archaeological presence in Puerto Rico of soursop, pepper/pimiento, tomato, and possibly maize. Furthermore, soursop and tomato are identified for the first time for the West Indies region as a whole. Pepper, papaya, maize, and others in the list of plant identifications (Table 5.17) have been recovered either from prehistoric sites on Puerto Rico or on other islands.

Papaya is documented prehistorically with the Ostiones culture-complex, based on its identification at the El Parking Site in Feature 34 (described above), which has a

radiocarbon date of cal. A.D. 656-855 (Weaver 1992). Papaya seems to have originated in Central America, later spreading under cultivation into Amazonia and other areas. Aside from the two sites in Puerto Rico, papaya has not otherwise been identified from archaeological sites in the Caribbean.

Capsicum pepper seeds were recovered from late prehistoric and Contact Period deposits at En Bas Saline, Haiti (discussed below). Domesticated Capsicum (annuum) pepper, as well as European grape and other provisions, were recovered from the wreckage of a ship (Nuestra Senora de Atocha) that was lost in 1622 shortly after it left the port of Havana, Cuba (Newsom and D. Hall, letter to C. Malcolm, 29 December 1987). The situation of domestication for Capsicum spp. is complex, with multiple domestications involving several species (Heiser 1969, 1990; Rindos 1980; and see Pickersgill 1984). According to Pickersgill (1984:106-123), wild Capsicum frutescens (aji/bird pepper) may have been domesticated in the Caribbean region, but not necessarily the Antilles. Domesticated and apparently wild or feral C. annuum and C. frutescens presently occur widely in the Caribbean region, including the Greater Antilles; domesticated C. chinense also is reported for the West Indies and adjacent regions (Liogier and Martorell 1982:158; Pickersgill 1984:109). Presently, it is impossible to distinguish which among these species the Ballajá pepper seeds represent.

Maize and tomato are believed to have first undergone domestication in Mexico (Manglesdorf 1974). When maize first arrived in the Caribbean islands is presently unknown. Maize kernals and cob fragments were recovered from late prehistoric-early historic contexts at En Bas Saline, Haiti (described below), and three pollen records tentatively suggest that maize was present on Hispaniola as early as the second millennium B.C. (Caribbean maize is discussed in detail in the sections below on Hispaniola.) Ballajá is the first record for the presence of tomato in the Caribbean.

Finally, to my knowledge Ballajá also produced the first record for coconut in the West Indies. Coconut is believed to be pan-tropical in terms of its prehistoric distribution, but not native to the Caribbean region (Liogier and Martorell 1982:222).

Several wild plants may have been supplementary items in the diets of the inhabitants of Barrio Ballajá. Interestingly, two of the important seed types recovered from the Lesser Antilles prehistoric deposits--specifically, mastic-bully and palm nut (Table 4.32)--were identified in the Ballajá samples (Tables 5.17 and 5.18). The use of these plant foods apparently extended across temporal and cultural boundaries, from the prehistoric era until well after European contact, and from Caribbean Indian to Hispanic San Juan.

Raspberry seeds (Rubus sp.) from Ballajá are similar to or identical to specimens mentioned previously from

prehistoric deposits at El Fresal, Puerto Rico. Likewise, the seeds from Ballajá were preserved by mineralization.

The goosefoot-family seed type (Chenopodiaceae; Tables 5.17 and 5.18) was described above in the discussion on El Fresal. Ballajá provides the third record for the archaeological presence this seed type, together with El Fresal and El Parking Site. At Ballajá, however, Chenopodiaceae plants may have existed as weeds growing around the city dwellings and buildings, and may not have been recognized as plant foods or medicines. All 28 Chenopodiaceae seeds from Ballajá were recovered exclusively from the Feature 57 hospital refuse/latrine (Table 5.18).

Certain of the cultivated taxa from Ballajá are examined below in more detail to better interpret their status as food items, and to at least tentatively assess their placement along the continua from wild to domesticated forms. It is necessary to establish the true nature of these plants because of their potential importance as homegarden species and their possible bearing on prehistoric human existence in Puerto Rico.

Cultivated plants from Ballajá

Seeds identified as papaya and as pepper (using the minimally descriptive epithet to make less implicit the presence of domesticated Capsicum spp. [pimiento/chili pepper]) from the Ballajá samples were analyzed beyond their initial identifications to clarify their taxonomy and discern whether they represent domesticated and, perhaps

also, introduced forms, or free-ranging wild taxa. This is an important distinction because domesticated plants, on the one hand, and wild plants, on the other, imply vastly different approaches to diet and food production (more intensive care and manipulation, versus casual, opportunistic fruit collection). Furthermore, even though the seeds much post-date the Tainos of Puerto Rico, we need to begin to document when domesticated forms actually appeared among the respective island cultures to fully address human adaptation and changing perspectives on land use and food production. Eventually, gaps in information and the documentation of ethnobotanical details between historic and prehistoric records should be filled as more data are gathered from Puerto Rico and other Caribbean islands.

Papaya, pepper, and maize were present in the Caribbean prior to European contact, as stated previously. The papaya seed from Feature 34 of the El Parking site does not differ morpologically from a wild form of papaya. Similarly, morphometric data can clarify whether the Ballajá papaya and pepper specimens came from domesticated or from wild forms of the potential housegarden plants. In addition to the more intensive morphometric analyses of papaya and pepper seeds, measurements of Ballaja seeds belonging to the two newly identified (for the Caribbean) plants--soursop and tomato--are reported below for future comparative purposes. Unfortunately, the tentative maize identification from

Ballaja is based on a distorted clay cast of a cob fragment that is not suitable for metric analysis, which could have helped disern genetic affinity.

Papaya. Size and the general morphology of the papaya seeds from Ballajá together suggest a closer affinity with domesticated forms of papaya than with wild papaya. However, fruit from cultivars as well as from wild types of papaya may be represented in the deposits. Metric data for the Ballajá papaya seeds are shown in Table 5.19. Ballajá papaya seeds have a broad size range, overlapping measurements from both wild and domesticated accessions (Tables 5.13 and 5.19; Figure 5.3). Ballajá papaya seeds are between 3.50 mm and 6.09 mm long, with widths ranging from 2.38-4.21 mm (mean length 4.90 mm, standard deviation 0.60; width 3.24 mm, standard deviation 0.44) (Table 5.19). Part of the greater variability within the Ballajá seed population, in contrast with the museum papaya accessions that have smaller standard deviations for seed length and width (Table 5.13), may be explained by the presence of very small seeds from Ballajá (smaller than papaya seeds from any of the modern specimens [Figure 5.3]). The small Ballajá seeds could represent ingested seeds that eventually were deposited in the household privys, whereas the collectors of seeds from modern fruits may have overlooked smaller specimens, producing a bias toward larger, easily collected seeds. Thus, in the modern papaya seed accessions, seeds at

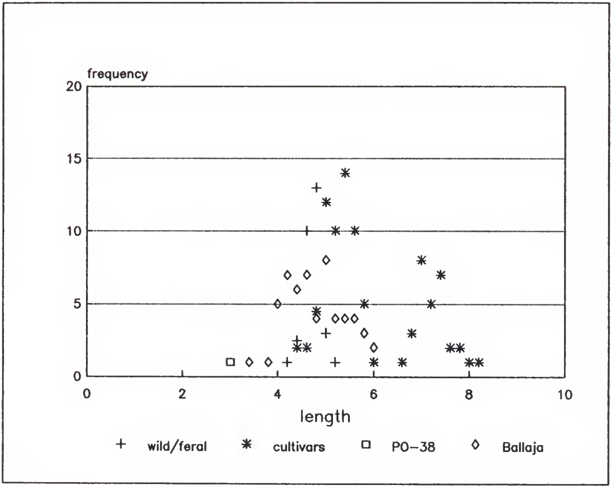


Figure 5.3. Papaya (Carica papaya) seed dimensions (in millimeters).

Table 5.19. Carica papaya seed measurements (mm), Ballajá Archaeological Project.

Provenience	Length	Width	W/L		Length	Width	W/L
Feat.48, Flot. 131:	4.72	2.89	0.61	Feat.25, Flot. 101:	5.67	2.82	0.50
n=5	5.34	3.52	0.66	n=11	4.96	3.26	0.66
	4.21	2.90	0.69		4.93	2.85	1.00
	4.53	3.38	0.75		5.05	3.33	0.66
	4.54	2.76	0.61		5.38	2.92	0.54
Feat.48, Flot. 132:	5.90	3.53	0.60		5.18	3.30	0.64
n=17	5.20	3.94	0.76		4.94	3.46	0.70
	5.83	4.17	0.72		4.38	2.38	0.54
	6.02	3.96	0.66		4.70	2.98	0.63
	5.62	3.95	0.70		4.18	2.47	0.59
	5.51	4.21	0.76		5.56	3.43	0.62
	6.09	4.11	0.67	Feat.25, Flot. 96:	4.15	2.93	0.71
	5.79	4.07	0.70	n=17	5.17	3.48	0.67
	5.84	3.81	0.65		4.17	2.73	0.65
	5.12	3.66	0.71		4.20	3.19	0.76
	5.39	3.43	0.64		5.19	3.46	0.67
	5.49	3.20	0.58		3.87	2.94	0.76
	5.05	3.51	0.70		5.50	3.45	0.63
	4.99	2.86	0.57		5.01	3.30	0.66
	4.52	3.66	0.81		4.65	2.64	0.57
	4.56	3.01	0.66		3.50	3.09	0.88
	4.48	3.09	0.69		5.02	3.32	0.66
Feat.18, Flot. 54:	4.12	2.64	0.64		4.32	3.13	0.72
Feat.35, Flot. 123:	4.55	3.43	0.75		4.64	2.71	0.58
Feat.94, Flot. 198:	4.36	3.00	0.69		4.38	3.08	0.70
n=4	5.62	3.32	0.59		4.63	2.64	0.57
	4.10	2.97	0.72		4.66	3.37	0.72
	4.39	2.89	0.66		4.77	3.14	0.66
Combined Mean:	4.90	3.24	0.67	Feat. 48 mean	5.22	3.53	
Stan. deviation:	0.60	0.44	0.08	Coeff.var.	10.87	12.95	
				Feat. 25 mean	4.74	3.06	
Coeffic. variation:	12.16	13.48	12.28	Coeff.var.	10.93	10.25	

the upward limits in size may reliably convey size at that extreme, while small seeds may be underrepresented.

Another possible explanation for the contrasts in the spread between the smallest and largest seeds from the archaeological compared with the modern populations is based on the number of individual fruits represented. That is, the museum accessions each represent single fruits, whereas the Ballajá seeds represent a minimum of five individual papayas (having been recovered from five separate proveniences). A single fruit predictably will have inherently narrower variability in terms of seed morphology than would be observed among a collection of fruits of different sizes and shapes (see, for example, Cowan and Smith 1992).

The coefficient of variation (C.V. = 100 x standard deviation/mean) (Nash 1965; Neter et al. 1978; Taylor 1990: 43, 174) may be applied to seed dimensions to more precisely measure morphological variability in and among populations. Moreover, the coefficient of variation (C.V.) has been applied to archaeological seed measurements to discern the presence of more than one fruit type or morphology, and perhaps also the effects of selective breeding and incipient domestication (Cowan and Smith 1992; Decker and Newsom 1988; King 1985). The combined C.V. for length for the Ballajá papaya seeds is 12.16 and the C.V. for width is 13.48 (Table 5.19). Both coefficients are relatively high (coefficients of around 5.0 are considered low and indicative of a fairly

homogeneous population; coefficients of around 8.0 or greater for seed dimensions are considered high). Even the coefficients for the individual features that produced a sufficient number of seeds (Features 25 and 48) are relatively high, at between 10.25 and 12.95 (Table 5.19). Consequently, the large coefficients of variation for the Ballajá seeds appear to reflect the presence of multiple fruits and perhaps also indicate a certain amount of variability of fruit size and morphology (compare, for example, the combined coefficients for the three cultivars in Table 5.13 [bottom], to wit, 16.76 length and 14.77 width; and see Rehm and Espig 1991). In addition to verifying that the Ballajá seeds represent a pooled seed population deriving from five or more individual fruits, the relatively large coefficients may document to some extent also the effects of gardening and selection, whether purposeful or intentional, in a direction away from wild papaya. More data are needed, however, to examine the latter situation.

There is, however, at least some indication of genetic plasticity or a broadened gene pool among the Ballaja papaya seeds reflected in the surface textures of the seed coats. Ballaja papaya seeds have well-developed furrowing and spines, intermediate in texture between seed coats of wild and those of domesticated forms of papaya. Thus, Ballajá papaya seeds, by seed coat texture and by size variability, seem to represent papaya varieties that were either

domesticated and/or were somewhere in the process of domestication. It is very likely that both wild and domesticated papaya are represented among the samples, particularly considering the range in seed size, with smaller individuals possibly having come from wild fruit. Moreover, the Ballajá seed population, deriving almost certainly from gardens and residential areas, predictably reflects greater genetic variability than would exist exclusively in the wild state. Particularly considering the greater opportunities for frequent hybridization as papaya varieties from different regions were imported and grown together (Anderson 1969; Harlan 1975; Rehm and Espig 1991; Rindos 1980).

Pepper. Unlike papaya, measurements of pepper (Capsicum sp.) seeds from Ballajá were difficult to produce because the seeds are few and none are whole. Diameter estimates from the seed fragments are between 3 and 4 mm. By comparison, wild Capsicum annuum (bird pepper) seeds from south Florida (n=12) have a mean diameter of 2.90 mm, with a range of 2.69-3.33 mm. Seed diameter measurements from two accessions (seeds measured: n=10; n=30) of domesticated chili pepper (Capsicum annuum) consistently exceed 3.5 mm (mean 4.12 mm, range 3.81-4.57 mm; mean 4.19 mm, range 3.86-4.57 mm). Additional seed measurements (n=30) from what is believed to be a C. chinense x C. annuum hybrid (Norris Williams, personal communication, February 1993) grown in Florida tend also to exceed 3.5 mm (mean 3.7 mm; range 3.37-

3.97 mm). Thus, while the estimated pepper seed diameters for Ballajá do not necessarily preclude wild Capsicum as the basis for the identification, the apparent diameters approaching 4 mm indicate that domesticated chili pepper is almost certainly present among the archaeological samples.

Soursop and tomato. Two soursop seeds were recovered relatively intact from Ballajá deposits (Table 5.18). The Feature 38 soursop seed, which lacks its seed coat, is 11.85 mm long, by 6.84 mm wide, and 4.40 mm thick. The other soursop seed is from Feature 57, and is 13.21 mm long, by 9.09 mm wide, and 4.51 mm thick. Tomato seed measurements are based on 24 seeds from Feature 48 (Table 5.20). Average seed length is 2.91 mm, and the average width is 1.85 mm. The tomato seeds range in length from 2.47-3.74 mm and in width from 1.39-2.58 mm.

Ballajá summary

Plant remains from eighteenth-century deposits in Barrio Ballajá, while relatively late in age, provide what is currently the earliest record in the Caribbean for several types of important plant foods, including three Old World plants (Table 5.17). Important New World plant foods that with the Ballajá analysis are documented for the first time in the Caribbean include soursop and tomato. Other noteworthy cultivated plants from the Ballajá excavations, including papaya, (chili) pepper, and tentatively identified maize, are known also from a pair of prehistoric sites. Combined, at least eleven native American plant foods were

Table 5.20. Lycopersicon (tomato) seed measurements (mm), Ballajá Archaeological Project.

Feature 48:

Length	Width*	
2.90	1.97	
2.48	1.91	+L
2.80	1.81	
2.68	1.63	
3.25	1.92	
3.74	1.95	
2.58	1.96	
2.82	1.49	+W
2.97	2.13	
3.18	2.58	
2.79	1.57	+W
2.72	1.39	+W
2.47	1.74	
2.54	1.63	+LW
2.62	1.91	
2.95	2.30	
2.66	1.67	
3.52	1.84	
3.51	1.82	
2.86	2.06	
2.86	1.81	
2.95	1.91	
3.02	1.79	
3.00	1.54	
2.47	1.39	Minimum
3.74	2.58	Maximum
2.91	1.85	Average
0.33	0.26	Stand. deviation
11.17	13.87	Coefficient of variation

*width at widest
+some distortion of this dimension (L = Length; W = Width)

identified among the samples from Barrio Ballajá; six of these plants--soursop, (chili) pepper, papaya, tomato, and maize--are among the most widely cultivated of indigenous American plants.

<u>Summary of Puerto Rico Archaeobotanical Assemblages</u>

More than forty types of plants are identified from among the archaeological assemblages of plant remains from Puerto Rico. Seeds and other non-wood identifications from the Puerto Rican sites are summarized in Table 5.21, and wood identifications are listed in Table 5.22. El Bronce plant data are from Pearsall (1985). The seed identifications from the Maria de la Cruz cave are by Cutler (in Rouse and Alegria 1990:22; note that Cutler's <u>Lucuma salicifolia</u> = <u>Pouteria</u> <u>campechiana</u> [<u>Flora of Guatemala</u>, Standley and William, 1966]).

Corroborative evidence for the use of certain plants was obtained from several of the sites. <u>Pouteria</u> sp., e.g., bulley-tree, is prominant among these, appearing at four of the six prehistoric sites (Tables 4.21 and 4.22). Identifications that are consistent with the data gathered from prehistoric sites in the Lesser Antilles (Chapter 4) include <u>Oenothera</u>, trianthema, mastic-bully, and palm seeds. While these are most likely representative of wild forms, any or all of these potential plant food resources may have been protected and/or grown by the various sites' inhabitants. There are few wood identifications in common with the Lesser Antillean sites; shared identifications are

Table 5.21. Seeds and nonwoody plant remains from sites in Puerto Rico.*

SCIENTIFIC/COMMON NAME	ARCHAIC Maria de La Cruz	----CUEVAS to OSTIONOID COMPONETS---- Maisabel (general)	Calle Cristo	El Fresal	El Parking	El Bronce	HIS-TORIC Ballajá	# SITES PLANT OCCURS
Annona (soursop)							x	1
Capsicum (pimiento)							x	1
Carica papaya (papaya)					x		x	2
Chenopodium (goosefoot)						x		1
Chenopodiaceae, (goosefoot family)				x	x	x		3
Citrus (orange/grapefruit)+							x	1
cf. Cleome (spider flower)					x			1
cf. Cocos nucifera (coconut)							x	1
Convovulaceae(morning glory)						x		1
cf. Desmodium (wild legume)						x		1
Ficus (carica) (Europ. fig)+							x	1
Hypoxis (stargrass)				x	x			2
Lycopersicon (tomato)							x	1
Malvastrum (false mallow)						x		1
cf. Mastichodendron foet. (mastic-bully)							x	1
Oenothera (primrose)				x	x			2
cf. Palmae (palm family)		(petiole)				(seed)	(seed)	3
Passiflora (maypop)				x				1
Persea amer. (wild avocado)	x							1
Physalis (ground cherry)							x	1
Poaceae (grass family)						x	x	2
Pouteria campechiana, (yellow sapote)	x							1
Rubus (wild raspberry)				x			x	2
Trianthema portulacastrum		x						1
Vitis (European grape)+							x	1
cf. Cactaceae (fruit/pad)							x	1
cf. Zea mays (maize cob)							x	1

*Modern seeds excluded. El Bronce data are from Pearsall (1985). + = Old World origin

Table 5.22. Wood identifications from sites in Puerto Rico. (Numbers are site ubiquity; El Fresal identifications are shown by presence [x] only, because the samples are few. El Bronce data are adapted from Pearsall [1985]; + = exotic.)

SCIENTIFIC/COMMON NAME	ARCHAIC Maria de La Cruz	CERAMIC AGE SITES Maisabel (combined)	Calle Cristo	El Fresal	El Parking	El Bronce	# SITES PLANT OCCURS
Acacia (acacia/aroma)					16		1
Andira inermis (moca)						4	1
Annona (pond-apple/soursop)						2	1
Bignoniac. (cedar or calabash)		6				28	2
Boraginaceae (borage family)						12	1
Capparis (caper tree)						32	1
Cassine (marble-tree)		6					1
Coccoloba (sea grape)						32	1
Combretaceae (e.g. buttonwood)						70	1
Croton (pepper bush)						70	1
Erythroxylon (false cocaine)						2	1
Exostema (W.I. quinine bark)						30	1
cf. Fabaceae (tree legume)						9	1
cf. Ficus (wild fig)				x			1
Guaiacum (lignum-vitae)						9	1
Inga (guaba)		6					1
Montezuma (maga)		25					1
Palmae (palm trunk)						2	2
Pouteria (bully-tree/jacana)		56	25	(x)			3
cf. Psidium (guava/guayaba)		6					1
Sapotaceae (sapote family)				(x)	25		2
cf. Sterculia (panama-tree)+		6					1
Tecoma stans (roble amarillo)						12	1
El Bronce types C, K, L, M/N, R, Q, S, V, X, and Y						x	
El Fresal types 1 through 11				x			
El Parking types 1-3					8		
Maisabel-1 (wild fig)		6					
TOTAL NO. WOOD TYPES:	-	8	2	14	5	24	

limited to caper tree, pepper bush, lignum-vitae, palm wood, and possibly a few others (Tables 4.33 and 5.22).

The apparently pre-Saladoid occurrences of Pouteria (bully-tree) at Maisabel are likely representative of the widespread native species Pouteria multiflora. Assuming the relatively deeply buried Pouteria wood in the sub-mound contexts from Maisabel is in fact present by natural deposition, then imported species such as P. sapota (zapote/mamey rojo) are excluded from consideration, at least in the early stages of midden accumulation. That is, unless zapote or something similar was not transported to the Caribbean Islands in conjunction with the even eariler Casimiroid migration. This possibility was suggested earlier in the discussion of Maisabel samples.

Thus, the question remains whether some or all of the Pouteria sp. wood from sites in Puerto Rico is from native or from one or more introduced species. Shedding some light on the question, seeds of Pouteria campechiana (yellow sapote) were identified from Archaic-age deposits in the Maria de La Cruz Cave near the northeast coast of Puerto Rico (Rouse and Alegria 1990:22; Table 5.21). This species is not listed among those Pouteria considered native to Puerto Rico (Liogier and Martorell 1982:136; Little and Wadsworth 1964; Little et al. 1974). However, Martin et al. (1987:61) assign the origin of P. campechiana loosely to Central America and the West Indies. Before much is made of this possible plant introduction, the seeds, which were

identified in 1963 (Rouse and Alegria 1990:22-23), should be reevaluated against the full array of species presently considered native to Puerto Rico and other Caribbean islands. It is probable that both native and introduced species of Pouteria were exploited by prehistoric inhabitants of Puerto Rico. The possibility of Archaic Age plant introductions is further supported by the apparently introduced Manilkara at Krum Bay, and the possibly introduced status of Oenothera which first appears at Hichmans' Shell Heap. Pouteria campechiana fruit is eaten fresh and in beverages; it is high in niacin, vitamins A and C, proteins, carbohydrates (Martin et al. 1978:61; Popenoe 1939).

Another important plant identification from the Archaic deposits in Maria de la Cruz cave is avocado. Specifically, carbonized seeds of a purportedly wild form were recovered with the 1948 excavation of the site (Rouse and Alegria 1990:22-23). Avocado is believed to have originated in Mexico (Ford 1984:180; Liogier and Martorell 1982:52: Martin et al. 1987:31). Therefore, wild avocado, like the three plants mentioned above, may first have been transported into the Caribbean islands by Archaic Age groups. However, just as was discussed earlier regarding wild papaya at the El Parking site, until more evidence is gathered introduction by drift or faunal dispersers is just as likely a possibility to account for avocado's early presence in Puerto Rico. That the seeds (avocado and papaya) seem to be

from wild forms, however, is not necessarily inconsistent with an association with human groups.

A distinctive feature of the Puerto Rico archaeobotanical assemblages that contrasts with the Lesser Antillean collections reviewed earlier is the conspicuous presence of plants that may have existed under cultivation, as opposed to strictly wild forms. Several important American homegarden species were identified in the archaeobotanical samples from Puerto Rico, including soursop, pepper/pimiento, papaya, tomato, palm family, avocado, and bully-tree/sapote. There is provisional evidence for a few additional homegarden trees, including guaba, guava, and Panama-tree (Tables 5.21 and 5.22). Currently, pepper and tomato are known only from historic period contexts excavated by the Barrio Ballajá Project. Soursop was possibly present and utilized prehistorically, based on wood specimens from El Bronce (Table 5.22). The rest of the plants are defintively associated with prehistoric deposits. Papaya, wild avocado, bully-tree, and yellow sapote (Tables 5.21 and 5.22) from the Puerto Rican sites provide the first archaeobotanical records for the presence of these plants in the Caribbean; all but bully-tree derive from other areas of the American tropics. Provisionally identified Panama-tree (Table 5.22) adds another to this list of potential prehistoric plant imports.

The analysis of botanical remains from archaeological sites in Puerto Rico has provided a body of evidence

suggesting that prehistoric human adaptation in Puerto Rico included gardening and perhaps also limited arboriculture. Moreover, the evidence strongly suggests that gardening practices and the importation of exotic species was initiated during the Archaic Age.

Unequivocably domesticated plant species are not identified among the archaeobotanical assemblages reviewed here from Puerto Rico, even though artifacts believed associated with plant staples like manioc (see Chapter 1) commonly occur in the Ceramic Age deposits. Direct evidence for domesticated plants currently is lacking from Puerto Rican sites. From an archaeobotanical perspective the absence of plant remains does not, however, necessarily preclude the possibility that domesticated plants, particularly those that are difficult to trace (e.g., manioc), were part of the diet of the inhabitants of the various sites. Thus far, maize, manioc, and other purported Taino crops, if they were indeed components of prehistoric subsistence in Puerto Rico, have eluded detection by archaeobotanical analysis.

CHAPTER 6

RESULTS OF ARCHAEOBOTANICAL ANALYSES: HISPANIOLA

Two sites on the island of Hispaniola were examined in the course of this study. En Bas Saline is a large Chican Ostionoid site (Carrier complex) on the north coast of Haiti. In addition to approximately 200 years of prehistoric Taino occupation, En Bas Saline is probably the location where Columbus established the fortification La Navidad in 1492 (Deagan 1986, 1987; Krieger 1929:476). The site was abandoned shortly following European contact.

The second site discussed in this results section is La Isabela, situated on the north coast of the Dominican Republic. La Isabela also is tied to Columbus; it is the place of the failed Spanish settlement initiated by Columbus in January 1494 (Deagan 1992; Krieger 1929:474-475). Unlike En Bas Saline, plant samples from Isabela are few and botanical preservation is very limited. Nevertheless, at least one of the species identified from Isabela is pertinent to this research and adds to the overall interpretation of plant use in the Caribbean islands.

There currently exists no direct evidence for the prehistoric presence of fully domesticated plants in Puerto Rico, or from any of the other aboriginal occupations discussed thus far. Nonetheless, artifacts--for example,

ceramic griddles, grater-board chips, and grinding implements--that generally are believed to have been associated with plant food production, in particular with staples such as manioc (Manihot esculenta), are abundantly represented at the sites discussed previously. Chert microliths, for example, occur among five of the El Parking site flotation samples (Chapter 5), and specimens from Features 11 and 60 at least superficially resemble grater-board chips (see, for example, DeBoer 1975:fig. 4h-m; Roth 1970). Nevertheless, in the absence of plant remains, however, lithic chips, griddle sherds, and grinding stones are insufficient evidence to suggest that crop production occurred, because it is equally plausible that these tools rendered wild tubers and grains edible. Furthermore, as mentioned previously, the pollen and isotopes records presently are inconclusive as to the presence of plant domesticates.

Excavations at En Bas Saline are the first in the Caribbean islands to recover what indisputedly are the remains of domesticated plants. Maize and manioc tubers from En Bas Saline provide the first evidence of the validity of the ethnohistorical record, confirming statements that these plants were food items in the West Indies. Moreover, these remains provide initial insights into the morphological characteristics and types of prehistoric maize and manioc in the region. Other possible plant domesticates were recovered from En Bas Saline as

well, and a rich array of wild plant resources also is documented by the archaeobotanical research. The next sections of this study describe the site of En Bas Saline and the various contexts from which archaeobotanical specimens were recovered; following that, the plant data are detailed and examined in view of their significance to the prehistoric Taino culture.

Hispaniola

En Bas Saline, Haiti

En Bas Saline is a large, oval-shaped town that covers approximately 200,000 square meters (Deagan 1986, 1987). The overall chronology of the site, based on radiocarbon and thermoluminescence dates, is from about A.D. 1250 to about A.D. 1500 (Alpha 3177-3179; Alpha 1912-1914; Beta 10526-10528; Beta 18172-18173; Beta 18469 [Deagan 1986; 1987]). The Taino town is the largest and the latest of the prehistoric occupations analyzed in this dissertation.

A prominent feature of En Bas Saline was a large central plaza, in the center of which stood what was probably the Taino chief's residence atop a small raised mound. The structure burned to the ground in the Fourteenth Century, based on a combined corrected B.P. (before present) date of 600+-70 years (cal. A.D. 1350+-70), or between A.D. 1280 and 1420. The structure seems to have been rebuilt, and apparently served as a focal point of activity up to the time Europeans arrived in 1492. Smaller house-structures were located about the edges of the plaza. Raised earthen

embankments and a band of concentrated midden debris form the northern, eastern, and southern perimeters of the town, respectively.

By all ethnohistoric accounts, the inhabitants of the early historic town were horticulturists with an emphasis on root crops. Prehistoric fields and horticultural plots associated with the town have not been located archaeologically, but the low concentration of midden debris on the raised earthen embankment along the northern edge of the site has raised speculation that this may have served as a conuco (see below) or planting area.

Sources of archaeobotanical samples

Archaeobotanical samples were taken from the central plaza area, the chiefly residence, smaller house-structures on the site periphery, and general midden deposits that define the edges of the site. All together, 106 samples were analyzed for plant remains (Table 6.1). The site is divided into individual gardens, which were designated during the project by letters. Samples analyzed and reported here derive from three general locations: the areas designated Gardens B, C, and E (Figure 6.1).

Four deposit periods, represented by three soil strata, were defined at the site. Horizons A and B1 (Table 6.1) belong to the Historic Period; Horizon B2 is very late prehistoric to possibly historic, and B3 is entirely prehistoric in age. Archaeobotanical samples were processed by one of two means, either by water-flotation or by fine-

Table 6.1. En Bas Saline, Haiti: samples analyzed for archaeobotanical data.

LOCATION	EXCAVATION UNIT	HORIZON	PROVENIENCE	SAMPLE CONTEXT	SAMPLE NUMBER	SAMPLE TYPE
Garden B	941.5N 1003E	B2	Feature 24 dog burial	burial	6989	flot
Garden B	1101.0N 970E	B3	Feature 31 Level 01	pit	7190	flot,carbon
Garden B	1101.0N 920E	B3	Feature 31 Level 02	pit	7198	flot,carbon
Garden B	1098.0N 970E	B3	Feature 31 Level 03	pit	7197	flot
Garden B	1101.0N 977E	B3	Feature 31 Level 03	pit	7213	flot,carbon
Garden B	1101.0N 920E	B3	Feature 31 Level 04	pit	7211	flot
Garden B	1101.0N 920E	B3	Feature 31 Level 04	pit	7332	flot,carbon
Garden B	1101.0N 970E	B3	Feature 31A Level 01	pit	7199	flot,carbon
Garden B	1098.0N 970E	B3	Feature 31B Level 01	pit	7202	flot
Garden B	1101.0N 970E	B3	Feature 33 Level 01	pit	7192	flot
Garden B	1101.0N 970E	B3	Feature 33 Level 03	pit	7215	flot
Garden B	1101.0N 970E	B3	Feature 33 Level 04	pit	7214	flot,carbon
Garden B	1101.0N 970E	B3	Feature 33A Level 01	pit	7216	flot
Garden B	1101.0N 970E	B3	Feature 35 Level 02	pit	7422	flot
Garden B	1101.0N 970E	B3	possible postmold-1	posthole fill	7527	flot
Garden B	1098.0N 970E	B3	possible postmold-3	posthole fill	7443	flot
Garden B	1101.0N 970E	B3	possible postmold-6	posthole fill	7530	flot
Garden B	1095.0N 970E	B3	Area 01 Level 01	feature-stain	7065	flot
Garden B	1101.0N 970E	B3	Area 01 Level 01	feature-stain	7191	flot,carbon
Garden B	1095.0N 970E	B3	Area 01 Level 02	feature-stain	7072	flot,carbon
Garden B	1101.0N 970E	B3	Area 03A Level 01	feature-stain	7334	flot,carbon
Garden B	1101.0N 970E	B3	Area 03B Level 01	feature-stain	7335	flot,carbon
Garden B	1105.0N 970E	B3	Area 04 Level 01	feature-stain	7331	flot
Garden B	1105.0N 970E	B3	Area 04 Level 04	feature-stain	7512	flot,carbon
Garden C	1000.0N 977E Sq. B	A	Zone 01 Lev. 2 NW & SE	general soil	6302	flot
Garden C	1000.0N 977E Sq. B	B1	Zone 02 Level 01 SW	general soil	6305	flot
Garden C	1000.0N 977E Sq. B	B3	Feature 10 Level 01	pit	6306	flot
Garden C	1000.0N 977E Sq. B	B3	Feature 11 Level 02	hearth-pit	6310	carbon
Garden C	1000.0N 977E Sq. B	B3	Feature 11 Level 03	hearth-pit	6312	carbon
Garden C	1000.0N 977E Sq. B	B3	Feature 11 Level 04	hearth-pit	6313	carbon
Garden C	1000.0N 977E Sq. B	B3	Feature 11 Level 05	hearth-pit	6316	flot,carbon
Garden C	1000.0N 977E Sq. B	B3	Feature 11 Level 06	hearth-pit	6318	carbon

Table 6.1--continued.

LOCATION	EXCAVATION UNIT	HORIZON	PROVENIENCE	SAMPLE CONTEXT	SAMPLE NUMBER	SAMPLE TYPE
Garden C	1000.0N 977E Sq. B	B3	Feature 11 Level 07	hearth-pit	6320	carbon
Garden C	1000.0N 977E Sq. B	B3	Feature 11 Level 08	hearth-pit	6324	carbon
Garden C	1000.0N 977E Sq. B	B3	Feature 11 all levels	hearth-pit	6317	carbon
Garden C	1000.0N 977E Sq. B	B3	Feature 11 Postmold-6	posthole fill	6851	carbon
Garden C	1001.5N 978E Sq. C	B3	Feature 15 Level 01	pit	6746	carbon
Garden C	1001.5N 978E Sq. C	B3	Feature 15 Level 02	pit	6748	carbon
Garden C	1001.5N 978E Sq. C	B3	Feature 15 Level 03	pit	6751	carbon
Garden C	1001.5N 978E Sq. C	B3	Feature 15 Levels 1-3	pit	6756	carbon
Garden C	1001.5N 978E Sq. C	B3	Feature 15 Level 04	pit	6752	carbon
Garden C	1001.5N 978E Sq. C	B3	Feature 15 Level 05	pit	6770	carbon
Garden C	1001.5N 978E Sq. C	B3	Feature 15 Area 02	pit	6750	flot
Garden C	1001.5N 978E Sq. C	B3	Feature 15B Area 06	pit	6773	flot,carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 03	pit 4-6-8	3851	carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 05	pit 4-6-8	3858	sieve,carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 06	pit 4-6-8	3862	sieve,carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 07	pit 4-6-8	3864	sieve,carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 08	pit 4-6-8	3866	carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 08	pit 4-6-8	3881	sieve,carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 10	pit 4-6-8	3883	carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 11	pit 4-6-8	3885	sieve,carbon
Garden E	944.0N 1017E	B1	Feature 04 Level 12	pit 4-6-8	3886	sieve,carbon
Garden E	942.0N 1017E	B1	Feature 06 Level 03	pit 4-6-8	3840	carbon
Garden E	942.0N 1017E	B1	Feature 06 Level 04	pit 4-6-8	3860	carbon
Garden E	942.0N 1017E	B1	Feature 06 Level 06	pit 4-6-8	3867	carbon
Garden E	942.0N 1017E	B1	Feature 06 Level 07	pit 4-6-8	3868	carbon
Garden E	942.0N 1017E	B1	Feature 06 Level 08	pit 4-6-8	3882	carbon
Garden E	942.0N 1017E	B1	Feature 06 Level 10	pit 4-6-8	3890	carbon
Garden E	944.0N 1017E	B1	Feature 08 Level 02	pit 4-6-8	3892	carbon
Garden E	944.0N 1017E	B1	Feature 08 Level 03	pit 4-6-8	3897	carbon
Garden E	944.0N 1017E	B1	Feature 08 Level 04	pit 4-6-8	3898	carbon
Garden E	942.0N 1017E	B1	Feature 08N Level 04	pit 4-6-8	3910	carbon
Garden E	944.0N 1017E	B1	Feature 08 Level 05	pit 4-6-8	3900	carbon

Table 6.1--continued.

LOCATION	EXCAVATION UNIT	HORIZON	PROVENIENCE	SAMPLE CONTEXT	SAMPLE NUMBER	SAMPLE TYPE
Garden E	944.0N 1017E	B1	Feature 08N Level 06	pit 4-6-8	3913	carbon
Garden E	944.0N 1017E	B1	Feature 4-6-8 base	posthole	3911	carbon
Garden E	combined units C10	B1	Feature 07 Level 01	pit	3856	carbon
Garden E	combined units C10	B1	Feature 07 Level 02	pit	3857	carbon
Garden E	943.5N 1000E Sq.7	B1	Feature 14 Level 01	large pit	6730	flot,carbon
Garden E	941.5N 1000E	B1	Feature 14 Level 03	large pit	6898	flot,carbon
Garden E	941.5N 1000E	B1	Feature 14 Level 03	large pit	6903	flot
Garden E	941.5N 1000E	B1	Feature 14 Level 05	large pit	6991	flot
Garden E	941.5N 1000E	B1	Feature 14A Lev. 1 E1/2	large pit	7020	flot,carbon
Garden E	941.5N 1000E	B1	Feature 14B Lev. 1 E1/2	large pit	7022	flot
Garden E	941.5N 1000E	B1	Feature 14B Lev. 2 E1/2	large pit	7044	carbon
Garden E	941.5N 1000E	B1	Feature 14C Lev. 2 E1/2	large pit	7023	flot
Garden E	941.5N 1000E	B1	Feature 14C Lev. 2 E1/2	large pit	7054	carbon
Garden E	combined unit C10	B1	Feature 20 Area 6 Lv.1	pit	3888	carbon
Garden E	943.5N 987E Sq.01	B1	Area 01 Level 01	midden	6340	flot,carbon
Garden E	943.5N 987E Sq.01	B1	Area 01	midden	3745	sieve
Garden E	941.5N 1003E	B1	Area 03 ash concentr.	ash	7040	sieve
Garden E	combined unit C10	B1	Area 04	ash/midden	3865	carbon
Garden E	941.5N 1003E	B1	Area 20 Level 01	midden	7035	sieve
Garden E	942.0N 1017E Sq.C	B1	Zone 01 Level 03	midden	3797	carbon
Garden E	943.5N 997E	?B1	Zone 02 Level 01	plaza/midden	7037	sieve
Garden E	943.5N 1000E Sq.7	B2	Feature 16 Level 03	pit	6789	carbon
Garden E	941.5N 1003E	B2	Feature 25 Level 01	wall trench	7017	flot,carbon
Garden E	941.5N 1003E	B2	Feature 25 Level 02	wall trench	7047	carbon
Garden E	941.5N 1003E	B2	Feature 26 Level 04	wall trench	7123	carbon
Garden E	939.5N 998.5E	B2	Feature 47A Level 01	midden/pit	7372	sieve
Garden E	941.5N 1009E	B2	Feature 49 Level 02	huge posthole	7465	carbon
Garden E	941.5N 1009E	B2	Feature 49 Level 03	huge posthole	7469	carbon
Garden E	941.5N 1009E	B2	Feature 49 Level 05	huge posthole	7487	carbon
Garden E	941.5N 1009E	B2	Feature 49 Level 06	huge posthole	7497	carbon
Garden E	941.5N 1009E	B2	Feature 49 Lv.7 PPM-10	possible post	7588	carbon
Garden E	941.5N 1009E	B2	Feature 49 Level 09	huge posthole	7585	carbon

Table 6.1--continued.

LOCATION	EXCAVATION UNIT	HORIZON	PROVENIENCE	SAMPLE CONTEXT	SAMPLE NUMBER	SAMPLE TYPE
Garden E	941.5N 1009E	B2	Feature 49 Level 11	huge posthole	7589	carbon
Garden E	941.5N 1009E	B2	Feature 49 Level 13	huge posthole	7592	carbon
Garden E	943.5N 1003E	B2	Area 06 Level 02	feature-stain	6863	carbon
Garden E	943.5N 1003E	B2	Area 06 Level 05	feature-stain	6880	carbon
Garden E	943.5N 1003E	B2	Area 06 Level 06	feature-stain	6882	carbon
Garden E	943.5N 1003E	B2	Area 06 Level 07	feature-stain	6884	carbon
Garden E	944.0N 1017E Sq.C	B2	Zone 02 Level 02	midden	3817	carbon
Garden E	939.5N 998.5E	B2	Zone 03 Level 05	midden	7374	sieve
Garden E	941.5N 1000E	B2	Zone 03 Level 05	midden	7010	carbon
Garden E	964.5N 1023E	B3	Area 6	pit/ash	3746	carbon

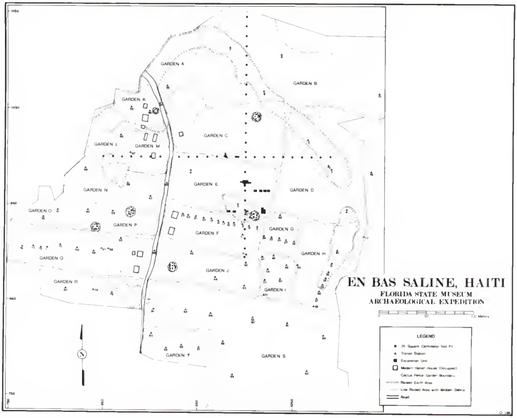


Figure 6.1. En Bas Saline site map (courtesy
Florida Museum of Natural History).

sieving procedures. The resultant plant data were supplemented with identifications of 1/4"-sized charcoal fragments from excavation screens. An overview of the archaeobotanical samples from En Bas Saline in terms of their respective gross constituents is presented in Table 6.2.

Most of the archaeobotanical samples derive from midden-filled pits, hearth-like deposits, and concentrations of burned materials. Several of these deposits are structurally complex and require additional descriptive information to place the results of analyses in context.

Garden Area B features. Feature 31 (including Features 31A, 31B) and Feature 33 are hearth-like deposits located within the confines of what appears to have been a small prehistoric structure on the earthen embankment at the northern edge of the site. Feature 35 also is a prehistoric-aged pit. Likewise, postmolds and smaller features located in Horizon B3 (Table 6.1) are prehistoric. Feature 24 is a dog burial (Table 6.1) that belongs to the latest prehistoric occupation of the site or contact period, based on the possible range in age indicated by radiocarbon assays from nearby deposits. All together, 24 Garden B deposits were analyzed for ethnobotanical data, 22 of which produced identifiable plant remains (Tables 6.1, 6.2).

Features 11 and 15, Garden Area C. Feature 11 is a large prehistoric pit located in the central plaza that was filled with burned food remains and other debris (Tables

Table 6.2. Overview of archaeobotanical samples from En Bas Saline, Haiti. (Seed counts include individual maize cupules and a cob fragment. FS 7191 partially includes sediment from the bottom of Feature 33.)

PROVENIENCE		SAMPLE TYPE	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FR. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	*SEED DENSITY -1	*SEED DENSITY -2
Garden B:												
Feat.24 Bur.01	FS 6989	flot	5.00	-	2.11	0.47	0.1	2	7	5	1.4	1.0
Feat.31 Lv.01	FS 7190	flot	5.00	-	6.47	1.00	0.2	0	22	20	4.4	4.0
Feat.31 Lv.01	FS 7190	carbon	-	3.51	-	3.51	-	22	0	0	-	-
Feat.31 Lv.02	FS 7198	flot	4.50	653.09	31.97	2.00	0.4	1	14	12	3.1	2.7
Feat.31 Lv.02	FS 7198	carbon	-	3.76	-	3.76	-	30	0	0	-	-
Feat.31 Lv.03	FS 7197	flot	2.80	273.30	8.46	2.15	0.8	10	75	15	26.8	5.4
Feat.31 Lv.03	FS 7213	flot	5.00	-	6.31	1.00	0.2	1	8	6	1.6	1.2
Feat.31 Lv.03	FS 7213	carbon	-	8.18	-	8.18	-	30	1	1	-	-
Feat.31 Lv.04	FS 7211	flot	5.00	-	3.08	0.50	0.1	3	9	0	1.8	-
Feat.31 Lv.04	FS 7332	flot	5.00	-	3.46	3.46	0.7	0	9	7	1.8	1.4
Feat.31 Lv.04	FS 7332	carbon	-	3.20	-	3.20	-	5	0	0	-	-
Feat.31A Lv.1	FS 7199	flot	4.50	243.42	20.76	20.76	4.6	0	4	3	0.9	0.7
Feat.31A Lv.1	FS 7199	carbon	-	7.20	-	7.20	-	30	0	0	-	-
Feat.31B Lv.1	FS 7202	flot	5.00	-	1.83	1.83	0.4	0	6	4	1.2	0.8
Feat.33 Lv.01	FS 7192	flot	5.00	-	6.86	6.80	1.4	0	4	4	0.8	0.8
Feat.33 Lv.03	FS 7215	flot	5.00	-	3.45	3.45	0.7	3	18	18	3.6	3.6
Feat.33 Lv.04	FS 7214	flot	5.00	-	2.20	0.87	0.2	0	24	20	4.8	4.0
Feat.33 Lv.04	FS 7214	carbon	-	3.50	-	3.50	-	20	0	0	-	-
Feat.33A Lv.1	FS 7216	flot	5.00	-	1.91	(trace)	-	0	14	14	2.8	2.8
Feat.35 Lv.02	FS 7422	flot	5.00	-	1.43	1.43	0.3	0	13	2	2.6	0.4
Pos.postmold-1	FS 7527	flot	5.00	-	0.04	0.04	<0.1	0	0	0	-	-
Pos.postmold-3	FS 7443	flot	5.00	-	0.64	0.64	0.1	1	62	0	12.4	-
Pos.postmold-6	FS 7530	flot	5.00	-	(trace	(trace)	-	0	0	0	-	-
Area 01 Lv.01	FS 7065	flot	5.00	-	13.63	13.63	2.7	25	11	7	2.2	1.4
Area 01 Lv.01+	FS 7191	flot	5.00	-	9.36	0.50	0.1	0	2	0	0.4	-
Area 01 Lv.01+	FS 7191	carbon	-	2.54	-	2.54	-	30	0	0	-	-
Area 01 Lv.02	FS 7072	flot	5.00	-	(trace	0.00	-	0	4	4	0.8	0.8
Area 01 Lv.02	FS 7072	carbon	-	1.31	-	1.31	-	1	0	0	-	-

Table 6.2--continued.

PROVENIENCE		SAMPLE TYPE	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	*SEED DENSITY -1	*SEED DENSITY -2
Area 03A Lv.1	FS 7334	flot	5.00	-	1.97	1.97	0.4	0	1	0	0.2	-
Area 03A Lv.1	FS 7334	carbon	-	0.60	-	0.60	-	9	0	0	-	-
Area 03B Lv.1	FS 7335	flot	5.00	-	2.19	2.10	0.4	0	31	4	6.2	0.8
Area 03B Lv.1	FS 7335	carbon	-	3.45	-	3.45	-	5	0	0	-	-
Area 04 Lv.01	FS 7331	flot	5.00	-	0.52	(trace)	-	0	9	9	1.8	1.8
Area 04 Lv.04	FS 7512	flot	5.00	-	0.62	0.62	0.1	0	9	5	1.8	1.0
Area 04 Lv.04	FS 7512	carbon	-	2.44	-	2.44	-	8	0	0	-	-
GARDEN C:												
Zone 1 Lv.02	FS 6302	flot	5.00	-	1.33	(trace)	-	0	45	12	9.0	2.4
Zone 2 Lv.01	FS 6305	flot	5.00	-	0.24	(trace)	-	0	5	1	1.0	0.2
Feat.10 Lv.01	FS 6306	flot	5.00	-	2.51	(trace)	-	0	0	0	-	-
Feat.11 Lv.02	FS 6310	carbon	-	22.18	-	8.45	-	0	0	0	-	-
Feat.11 Lv.03	FS 6312	carbon	-	60.49	-	12.90	-	0	5	5	-	-
Feat.11 Lv.04	FS 6313	carbon	-	80.12	-	35.53	-	0	10	10	-	-
Feat.11 Lv.05	FS 6316	flot	5.00	-	4.23	0.00	-	0	4	4	0.8	0.8
Feat.11 Lv.05	FS 6316	carbon	-	51.13	-	6.74	-	0	19	19	-	-
Feat.11 Lv.06	FS 6318	carbon	-	46.87	-	7.91	-	0	7	7	-	-
Feat.11 Lv.07	FS 6320	carbon	-	46.76	-	20.00	-	0	0	0	-	-
Feat.11 Lv.08	FS 6324	carbon	-	6.35	-	1.45	-	0	0	0	-	-
Feat.11 (all)	FS 6317	carbon	-	46.41	-	9.58	-	0	1	1	-	-
Feat.11 PPM-6	FS 6851	carbon	-	5.20	-	5.20	-	0	0	0	-	-
Feat.15 Lv.01	FS 6746	carbon	-	9.07	-	4.81	-	0	0	0	-	-
Feat.15 Lv.02	FS 6748	carbon	-	7.92	-	3.90	-	0	0	0	-	-
Feat.15 Lv.03	FS 6751	carbon	-	11.25	-	8.85	-	0	0	0	-	-
Feat.15 Lv.1-3	FS 6756	carbon	-	7.95	-	6.33	-	0	0	0	-	-
Feat.15 Lv.04	FS 6752	carbon	-	73.26	-	47.03	-	40	0	0	-	-
Feat.15 Lv.05	FS 6770	carbon	-	14.21	-	1.51	-	0	1	1	-	-
Feat.15 Ar.02	FS 6750	flot	5.00	-	2.11	3.02	0.6	0	0	0	-	-
Feat.15 Ar.02	FS 6750	carbon	-	41.00	-	17.88	-	0	0	0	-	-
Feat.15B Ar.06	FS 6773	flot	5.00	-	0.49	1.35	0.3	0	1	1	0.2	0.2

Table 6.2--continued.

PROVENIENCE	SAMPLE TYPE	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	*SEED DENSITY -1	*SEED DENSITY -2
Feat.15B Ar.06 FS 6773	carbon	-	3.38	-	0.00	-	0	0	0	-	-
GARDEN E:											
Feat.04B Lv.03 FS 3851	carbon	-	5.78	-	5.78	-	38	0	0	-	-
Feat.04 Lv.05 FS 3858	sieve	0.50	3.46	-	2.61	5.2	0	0	0	-	-
Feat.04 Lv.05 FS 3858	carbon	-	3.92	-	3.92	-	0	0	0	-	-
Feat.04 Lv.05 FS 3858	carbon	-	93.61	-	93.61	-	89	0	0	-	-
Feat.04 Lv.06 FS 3862	sieve	0.50	3.49	-	1.12	2.2	0	0	0	-	-
Feat.04 Lv.06 FS 3862	carbon	-	109.44	-	109.44	-	95	0	0	-	-
Feat.04 Lv.07 FS 3864	sieve	0.50	4.09	-	3.55	7.1	0	0	0	-	-
Feat.04 Lv.07 FS 3864	carbon	-	5.12	-	5.12	-	0	0	0	-	-
Feat.04 Lv.07 FS 3864	carbon	-	80.08	-	80.08	-	88	0	0	-	-
Feat.04 Lv.08 FS 3866	carbon	-	101.00	-	101.00	-	0	0	0	-	-
Feat.04 Lv.08 FS 3881	sieve	0.50	2.31	-	0.72	1.4	0	4	1	8.0	2.0
Feat.04 Lv.08 FS 3881	carbon	-	42.00	-	42.00	-	45	0	0	-	-
Feat.04 Lv.10 FS 3883	carbon	-	8.34	-	8.34	-	32	0	0	-	-
Feat.04 Lv.11 FS 3885	sieve	0.50	3.43	-	0.88	1.8	0	18	1	36.0	2.0
Feat.04 Lv.11 FS 3885	carbon	-	1.93	-	1.93	-	0	0	0	-	-
Feat.04 Lv.12 FS 3886	sieve	0.50	3.18	-	1.64	3.3	0	0	0	-	-
Feat.04 Lv.12 FS 3886	carbon	-	1.89	-	1.89	-	0	0	0	-	-
Feat.04 Lv.12 FS 3886	carbon	-	14.30	-	14.30	-	9	0	0	-	-
Feat.06 Lv.03 FS 3840	carbon	-	3.40	-	3.40	-	3	0	0	-	-
Feat.06 Lv.04 FS 3860	carbon	-	0.58	-	0.58	-	0	0	0	-	-
Feat.06 Lv.04 FS 3860	carbon	-	14.05	-	14.05	-	27	0	0	-	-
Feat.06 Lv.06 FS 3867	carbon	-	7.07	-	7.07	-	12	0	0	-	-
Feat.06 Lv.07 FS 3868	carbon	-	0.40	-	0.40	-	1	0	0	-	-
Feat.06 Lv.08 FS 3882	carbon	-	7.23	-	7.23	-	1	0	0	-	-
Feat.06 Lv.10 FS 3890	carbon	-	19.81	-	19.81	-	38	0	0	-	-
Feat.08 Lv.02 FS 3892	carbon	-	(trace)	-	(trace)	-	2	0	0	-	-
Feat.08 Lv.03 FS 3897	carbon	-	3.16	-	3.16	-	6	0	0	-	-
Feat.08 Lv.04 FS 3898	carbon	-	1.19	-	1.19	-	3	0	0	-	-

Table 6.2--continued.

PROVENIENCE	SAMPLE TYPE	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	*SEED DENSITY -1	*SEED DENSITY -2
Feat.08N Lv.04 FS 3910	carbon	-	0.91	-	0.91	-	1	0	0	-	-
Feat.08 Lv.05 FS 3900	carbon	-	0.86	-	0.86	-	3	0	0	-	-
Feat.08N Lv.06 FS 3913	carbon	-	1.90	-	1.90	-	6	0	0	-	-
Feat.4-6-8 base FS 3911	carbo	-	waterlogged	-	-	-	15	0	0	-	-
Feat.07 Lv.01 FS 3856	carbon	-	8.39	-	8.39	-	15	0	0	-	-
Feat.07 Lv.02 FS 3857	carbon	-	1.26	-	1.26	-	4	0	0	-	-
Feat.14 Lv.01 FS 6730	flot	5.00	-	0.34	0.00	-	0	0	0	-	-
Feat.14 Lv.01 FS 6730	carbon	-	4.83	-	1.82	-	0	0	0	-	-
Feat.14 Lv.03 FS 6898	flot	5.00	-	3.23	0.46	0.1	0	74	34	14.8	6.8
Feat.14 Lv.03 FS 6898	carbon	-	1.60	-	1.60	-	4	0	0	-	-
Feat.14 Lv.03 FS 6903	flot	5.00	-	1.30	0.00	-	0	47	46	9.4	9.2
Feat.14 Lv.05 FS 6991	flot	5.00	-	2.65	0.50	0.1	2	38	34	7.6	6.8
Feat.14A Lv.01 FS 7020	flot	5.00	-	2.68	0.00	-	0	160	159	32.0	31.8
Feat.14A Lv.01 FS 7020	carbon	-	1.51	-	1.51	-	16	0	0	-	-
Feat.14B Lv.01 FS 7022	flot	5.00	-	0.93	0.50	0.1	5	10	10	2.0	2.0
Feat.14B Lv.02 FS 7044	carbon	-	0.08	-	0.08	-	1	0	0	-	-
Feat.14C Lv.01 FS 7023	flot	5.00	-	1.15	0.50	0.1	2	3	3	0.6	0.6
Feat.14C Lv.02 FS 7054	carbon	-	0.26	-	0.26		2	0	0	-	-
Area 06 Un.C10 FS 3888	carbon	-	3.17	-	3.17	-	8	0	0	-	-
Area 01 Lv.01 FS 6340	flot	5.00	-	0.79	0.00	-	0	1	1	0.2	0.2
Area 01 Lv.01 FS 6340	carbon	-	4.56	-	4.56	-	0	0	0	-	-
Area 01 Hz.B1 FS 3745	sieve	0.50	3.40	-	0.63	1.3	1	4	4	8.0	8.0
Area 03 Ash FS 7040	sieve	3.50	639.95	-	3.68	1.1	21	6	3	1.7	0.9
Area 04 FS 3865	carbon	-	5.45	-	5.45	-	18	0	0	-	-
Area 20 Lv.01 FS 7035	sieve	1.75	480.24	-	1.46	0.8	6	6	4	3.4	2.3
Zone 01 Lv.03 FS 3797	carbon	-	1.01	-	1.01	-	2	0	0	-	-
Zone 02 Lv.01 FS 7037	sieve	4.00	191.37	-	0.03	>0.1	0	20	15	5.0	3.8
Feat.16 Lv.03 FS 6789	carbon	-	37.13	-	22.07	-	0	0	0	-	-
Feat.25 Lv.01 FS 7017	flot	5.00	-	6.11	12.12	2.4	0	6	6	1.2	1.2
Feat.25 Lv.01 FS 7017	carbon	-	126.43	-	126.00	1	40	2	2	-	-

Table 6.2--continued.

PROVENIENCE	SAMPLE TYPE	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN- SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	*SEED DENSITY -1	*SEED DENSITY -2
Feat.25 Lv.02 FS 7047	carbon	-	0.97	-	0.97	-	6	0	0	-	-
Feat.26 Lv.04 FS 7123	carbon	-	-	-	C/14	-	0	0	0	-	-
Feat.47A Lv.01 FS 7372	sieve	5.00	715.03	-	4.13	0.8	30	11	11	2.2	2.2
Feat.49 Lv.02 FS 7465	carbon	-	-	-	C/14	-	0	0	0	-	-
Feat.49 Lv.03 FS 7469	carbon	-	43.25	-	43.25	-	30	2	1	-	-
Feat.49 Lv.05 FS 7487	carbon	-	-	-	C/14	-	0	0	0	-	-
Feat.49 Lv.06 FS 7497	carbon	-	14.42	-	14.42	-	30	0	0	-	-
Feat.49 Lv.07 FS 7588	carbon	-	35.10	-	5.02	-	30	0	0	-	-
Feat.49 Lv.09 FS 7585	carbon	-	12.18	-	12.18	-	25	0	0	-	-
Feat.49 Lv.11 FS 7589	carbon	-	4.09	-	4.09	-	19	0	0	-	-
Feat.49 Lv.13 FS 7592	carbon	-	6.74	-	6.74	-	8	0	0	-	-
Area 06 Lv.02 FS 6863	carbon	-	1.90	-	1.90	-	17	0	0	-	-
Area 06 Lv.05 FS 6880	carbon	-	3.60	-	3.60	-	49	0	0	-	-
Area 06 Lv.06 FS 6882	carbon	-	1.70	-	1.70	-	13	0	0	-	-
Area 06 Lv.07 FS 6884	carbon	-	28.05	-	28.05	-	75	0	0	-	-
Zone 02 Lv.02 FS 3817	carbon	-	0.19	-	0.19	-	0	0	0	-	-
Zone 03 Lv.05 FS 7374	sieve	5.00	833.52	-	2.25	0.5	6	0	0	-	-
Zone 03 Lv.05 FS 7010	carbon	-	6.15	-	6.15	-	21	0	0	-	-
Area 06 FS 3746	carbon	-	6.69	-	0.00	-	0	0	0	-	-
TOTALS:		214.55	3182.06	159.36	894.48		1296	867	564		

*Seed Density-1 is based on the total seed count, including modern seeds; Density-2 is based exclusively on the presence of archaeological seeds (volumetric samples only).

6.1, 6.2). Feature 15 (and 15B; Table 6.1) is a similar feature, and is temporally and spatially associated with Feature 11. Both features may have functioned as communal hearths, perhaps involved in ceremonial activities at the site. The pits are roughly rectangular, relatively straight-sided, and flat-bottomed; Feature 11 measured approximately 1 m deep and 1.5 m across (Figure 6.2; Williams and Deagan 1986). Four possible postmolds occur at the corners of Feature 15. Both features were densely filled with plant-food remains, ash, shells, coral, foodbone, clay griddle fragments, and pottery, including in Feature 11 the remains of more than 140 ceramic vessels (Cusick 1989). The diverse array of materials, along with the centralized location, form the basis for the assumption that Features 11 and 15 were important to ritual feasting activities.

Features 11 and 15 occurred in one of the lowest stratigraphic levels at the site. Feature 11 has a combined corrected age of 600 +/-70 B.P., or between AD 1280 and 1420 (based on ceramic thermoluminescence and charcoal radiocarbon dates [Alpha 3177-3179; Alpha 1912-1914; Beta 10526-10528; Beta 18172-18173; Beta 18469]). Nine archaeobotanical samples come from Feature 11 (Table 6.1). An additional eight samples were removed from associated Feature 15 and 15B deposits. Aside from these, three additional Garden C contexts were analyzed (Tables 6.1,

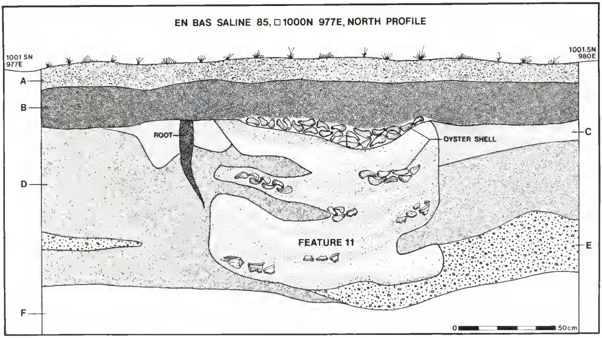


Figure 6.2. En Bas Saline Feature 11 (courtesy Florida Museum of Natural History).

6.2), one of which (Feature 10) contained no recognizable plant remains.

Garden Area E deposits. Sixty two samples from Garden E (which contained the raised mound in the central area) were analyzed for the presence of preserved botanical specimens. Several samples of plant remains derive from prehistoric floor and wall deposits belonging to the large, centrally located structure (possible chief's residence) that burned in the Fourteenth Century. Among the samples from the central structure are those from Features 26, 47A, and 49 (Tables 6.1, 6.2). Charcoal from Feature 26-Level 4 (FS 7123) produced a radiocarbon date of 720+-50 B.P. (Beta-46759), or approximately A.D. 1230+-50. Feature 49 included the remains of what appears to have been an extremely large burned post (FS 7588); sample 7487 from Level 5 of Feature 49 has a radiocarbon date of 630+-60 (ca. A.D. 1320+-60 [Beta-46763]). Sample 3888, designated Area 6 from within Feature 20 (Table 6.1), is another possible post from the burned structure; it has a radiocarbon date of 640+-60 B.P. (Beta-10527), or 1310+-60 A.D. (cal. 1255-1405 A.D., 1 sigma).

Additional Area 6 samples are numbers 6863-6884 in Tables 6.1 and 6.2. By carbon-14 determination, these samples demonstrate the continued use of the central mounded area, following the fourteenth-century conflagration. Sample 6882 (Area 6, Level 6) produced a radiocarbon date of

440+-60 B.P., or approximately A.D. 1510+-60, uncorrected; the calibrated date is A.D. 1410+-60.

Feature 14 (and 14A-C; Table 6.1) is from a very large, burned post apparently located at the edge of the large central structure thought to be the chief's residence, and belonging to the Contact Period. Its fill contained a small fragment of glass. Feature 16 is associated with Feature 14. Samples from Feature 25 and Areas 1, 3, 4, and 20 (Table 6.1, samples 6340, 3745, 7040, 3865, and 7035) represent ash and midden concentrations from the central structure that date to the late prehistoric or shortly after the time of European contact (1440+-70, 1410+-10 A.D; domesticated pig--Sus scrofa--was identified in the faunal analysis of the Area 1 sample [FS 3745]).

Sample 7037 (Zone 2, Level 1) is from the central plaza area. Bone from domesticated pig was recovered with this sample and early European artifacts were encountered in the same general stratum, thus assigning the sample to the Contact Period. Features 4, 6, and 8 are also located in the central plaza area. The individually designated features are distinguished by soil color and position, but in fact they derive from a single large, well-like pit (Table 6.1, Garden E samples 3840-3913; Figure 6.3). The large feature dates to the contact period based on radiocarbon determinations and the presence of introduced pig (Sus scrofa) and rat (Rattus rattus) (radiocarbon date from sample 3885 [Table 6.1], level 11 of Feature 4: 430+-80

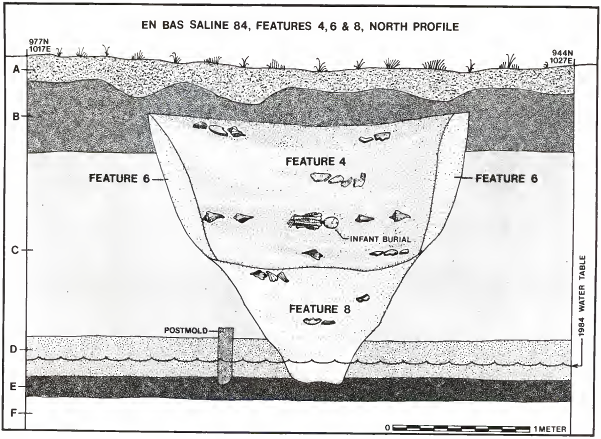


Figure 6.3. En Bas Saline Feature 4-6-8 (courtesy Florida Museum of Natural History).

B.P. [Beta-10526; 1520+-80 A.D., cal. 1340-1645, 1 sigma]; radiocarbon date from sample 3897, Level 3 of Feature 8: 340+-70 B.P. [Beta-10528; 1610+-70 A.D., cal. 1420-1650, 1 sigma]).

En Bas Saline archaeobotanical data

Plant identifications. Table 6.3 presents the archaeobotanical identifications from En Bas Saline. The total number of plant types identified is 72. At least 50 types of plant are probably contemporaneous with the Taino occupation of the site. The remainder of the identifications are of modern seeds.

Domesticated species among the En Bas Saline samples include maize (Zea maize), manioc (Manihot esculenta), and probably also sweet potato (Ipomoea batatas). These are discussed in detail below. Possible homegarden plants include pepper, Oenothera, palm family, and two to three Sapotaceae, including woods that by anatomy (Record and Hess 1942-1948) classify with the genera Manilkara (bullet-wood), on the one hand, and Dipholis/Chrysophyllum (bustic/star-apple), on the other. The cf. Sapotaceae seed fragments (Table 6.3) are very similar to Manilkara or Mastichodendron hard seed coat fragments from Barrio Ballaja and four of the Lesser Antilles sites (Table 4.32). Similarly, the palm-family seed coats from En Bas Saline are reminiscent of fragments discussed earlier from sites in Puerto Rico and the Lesser Antilles. Note also that Veloz Maggiolo and Ortega (1976) report that palm-like seed coat fragments

Table 6.3. Plant identifications from En Bas Saline, Haiti.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Domesticated species:		
cf. Manihot esculenta	manioc, cassava (yuca)	tuber
Zea mays	maize (maíz, malojo)	kernel, cob
cf. Zea mays	monocotyledonous tissue	stem
Possible housegarden species:		
cf. Annona sp.	soursop (guanábana)	seed
Capsicum sp.	pepper, pimiento (ají)	seed
Fabaceae, cf. Inga sp.	tree-legume (guaba)	seed, wood
cf. Melicoccus bijugatus	genip (Quenepa)	wood
Oenothera sp.	evening primrose	seed
Palmae	palm family	wood, fiber
cf. Palmae	palm family	fruit, bud
cf. Psidium guajava	guava (guayaba)	seed
Sapotaceae, Dipholis/ Chrysophyllum-type	sapote family, bustic or star-apple (caimito)	wood
Sapotaceae, Manilkara-type	bullet-wood (ausubo) type	wood
cf. Sapotaceae	sapote family	seed
Wild edible plants:		
Amaranth/Chenopodiaceae	amaranth/chenopod families	seed
Chenopodiaceae	goosefoot family	seed
Poaceae, panicoid*	grass (e.g. Setaria sp.)	seed
Portulaca spp.*	purslane (don diego)	seed
Solanaceae (Solanum sp.)	nightshade family	seed
Trianthema portulacastrum	trianthema, (verdolaga de hoja ancha)	seed
Other:		
Avicennia germinans	black mangrove	wood
Bumelia sp.	boxwood (lechecillo)	wood
cf. Colubrina sp.	snake-bark (sanguinaria)	wood
Conocarpus erectus	buttonwood (mangle botón)	wood
Conocarpus/ Zanthoxylum-type	buttonwood/satinwood type	wood
cf. Eugenia sp.	stopper (anguila)	wood

Table 6.3--continued.

TAXON	COMMON NAME	PLANT PART
Fabaceae*	legume family (wild)	seed
Fabaceae	legume family (wild)	fruit
Genipa/ Gossypiospermum-type	jagua/W.Indian boxwood type	wood
cf. Guazuma ulmifolia	West Indian elm (guácima)	wood
Hura crepitans	monkey pistol (javillo)	wood
Hypoxis sp.	yellow stargrass (coquí)	seed
cf. Lauraceae	laurel fam. (wood 12, 1984)	wood
Licaria/Zanthoxylum-type	sweetwood/satinwood	wood
Malvaceae, Sida/Malva	mallow family, broomweed	seed
Metopium/Ocotea-type	poison wood/spicewood type	wood
Myrtaceae, Psidium/Eugenia	myrtle family, guava or stopper (guayaba, anguila)	wood
cf. Myrtaceae	e.g. Eugenia (stopper)	fruit
Pinus sp., section diploxylon	hard pine group, (Pinus occidentalis)	wood
cf. Poaceae	grass family	seed
Rhizophora mangle	red mangrove, (mangle colorado)	wood
Uniden. wood-type 1	En Bas Saline-10 (1984), pores solitary and in short multiples; axial parenchyma strongly confluent-banded, cf. Celtis/Ficus/Melicoccus (cockspur, fig, genip)	wood
Uniden. wood-type 2	En Bas Saline-15, parenchyma terminally banded, cf. Erithalis/ Comocladia	wood
Unidentified hardwood	liana-type anatomy	wood
Uniden. seed-type 1	spherical, 2.5mm diam.	seed
Uniden. seed-type 2	(moonseed-like)	seed
Uniden. seed-type 3	lobed, very small	seed
Uniden. seed-type 4	large, maize kernel-like	seed
Uniden. seed(?)-type 5	crescent-shaped, no testa	(seed)
Uniden. endocarp/ periderm	glandular surface	fruit/bark
Modern seeds:		
Amaranthus sp.	amaranth (blero)	seed
Argemone mexicana	Mexican poppy (cardo santo)	seed
Asteraceae	sunflower family	seed

Table 6.3--continued.

TAXON	COMMON NAME	PLANT PART
cf. Chenopodiaceae	goosefoot family, radially ridged	seed
cf. Cyperus sp.	sedge-type seed	seed
Dactyloctenium aegyptium	crowfoot grass (Old World)	seed
Euphorbia nutans	euphorb	seed
Euphorbiaceae, cf. Ricinus (small, 7 mm)	castor-bean like, not manioc	seed
Fabaceae	legume family	seed
Malvaceae, Malva/Sida sp.	mallow family	seed
Mollugo sp.	carpet weed (alfombra)	seed
Poaceae, panicoid	panicoid grass(Setaria sp.)	seed
Poaceae	grass family	seed
Portulaca sp.	purslane	seed
Portulacaceae	purslane family	seed
Psidium guajava	guava (guayaba)	seed
Solanaceae, cf. Physalis	cf. ground cherry	seed
cf. Urena lobata	bur (cadillo)	fruit
Unidentified seed	crenate surface	?seed
Unidentified seed	yellow, triangular, 1.5mm	seed
Unidentified seed	spherical form	seed
Unidentified fruit	lobed, small	fruit

*Representatives of panicoid grass, purslane, and a small (ca. 3mm length), wild-type legume seed occur also in the modern seed assemblage. Thus, the carbonized counterparts may have no direct association with archaeological com-components of the site, but rather, are likewise modern and recently intrusive.

(possibly corozo [Acrocomia sp.] and royal palm [Roystonea hispaniolana]) have been recovered from perceramic contexts in the Dominican Republic. Four additional homegarden species are provisionally identified, including soursop (Annona sp.), guaba (Inga sp.), genip or guenepa (Melicoccus bijugatus), and guava (Psidium guajava) (Table 6.3).

Several of the possible homegarden plants from En Bas Saline were also identified in archaeobotanical samples from Puerto Rico and the Lesser Antilles. These include evening primrose (Oenothera sp.), palm family seeds, and Sapotaceae wood and seed coat fragments (Chapters 4 and 5), and guaba and cf. guava were identified in prehistoric contexts from Maisabel, Puerto Rico. Pepper and cf. soursop seeds also were previously identified, but only in conjunction with eighteenth-century deposits at Barrio Ballajá, Puerto Rico. The presence of these two genera at En Bas Saline marks the first prehistoric record for the Caribbean, and genip (Melicoccus, provisional identification) is identified for the first time in Caribbean archaeology.

Possible wild plant-food resources from En Bas Saline include Amaranthaceae/Chenopodiaceae, goosefoot-family, panicoid grass, portulaca, Solanum sp. (nightshade), and trianthema (and palm; listed above with the potential homegarden plants). Trianthema (Figure 6.4) is the same plant with high-protein seeds as was recovered from Krum Bay and from Maisabel, although the evidence for use of trianthema is stronger at En Bas Saline (discussed below).

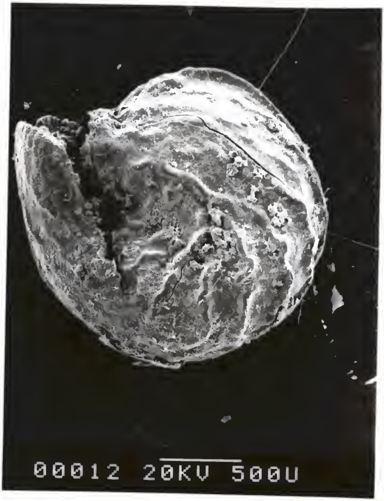


Figure 6.4. Trianthema seed from En Bas Saline, Field Sample 7422 (39x).

The goosefoot-family seed type (Chenopodiaceae) also is the same or very similar to the specimens described from the Puerto Rican deposits (Chapter 5). Generally, all parts of plants belonging to the families Amaranthaceae and Chenopodiaceae are edible, but more evidence is required in order to discern whether these plants were exploited for food by the inhabitants of En Bas Saline. Similarly, panicoid grass and portulaca seeds were recovered in samples from Puerto Rico and the Lesser Antilles, but in no case is there clear evidence of these taxa actually having been used by the prehistoric occupants of those sites. The entire portulaca plant is edible. Portulaca seeds were recovered at En Bas Saline both in carbonized and uncarbonized, apparently modern, form. Thus, portulaca is not clearly or definitively part of the archaeological record. The same may be true of panicoid grass seeds in En Bas Saline deposits, some of which are not carbonized. However, there is a meager amount of contextual evidence suggesting the possibility that panicoid grasses were exploited by the inhabitants of En Bas Saline. This is discussed in more detail below.

Solanum sp. (nightshade) is a provisional seed identification from En Bas Saline. Plants belonging to this genus may have been exploited by people at the site--perhaps for medicinal purposes (Ayensu 1981)--but until more evidence is gathered it is impossible to know if the plants were utilized by the Taino people. Finally, the last of the

wild plants identified from En Bas Saline is stargrass (Hypoxis sp.). Stargrass, like some of the others mentioned above, also appeared in the prehistoric plant assemblages from Puerto Rico, however. Stargrass has no recorded economic value.

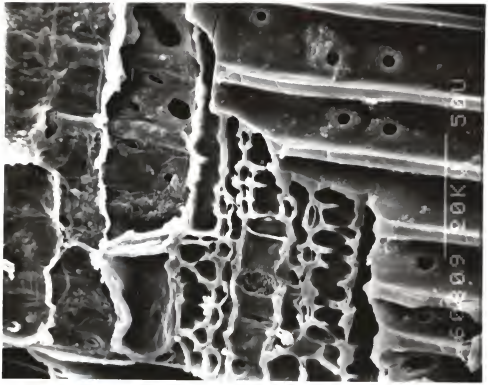
Possible fuelwoods from En Bas Saline include 21 different types (Table 6.3) (Little 1983; National Academy of Sciences 1980, 1983). Three prominent mangrove species of the Caribbean basin are represented, including Avicennia germinans (black mangrove), Rhizophora mangle (red mangrove), and Conocarpus erectus (buttonwood). Other types of angiospermous wood include, Bumelia sp. (boxwood), cf. Colubrina sp. (snake-bark), cf. Eugenia sp. (stopper), Genipa/Gossypiospermum-type (jagua/West Indian boxwood), cf. Guazuma ulmifolia (West Indian elm), Hura crepitans (monkey pistol), cf. Lauraceae (laurel family), Licaria/Zanthoxylum-type (sweetwood/satinwood), Metopium/Ocotea-type (poison wood/spicewood), Myrtaceae (myrtle family), the two Sapotaceae types that were mentioned above, cf. Inga sp. (guaba), and cf. Melicoccus (genip). Two additional hardwoods have been described by anatomy (En Bas Saline types 10 and 15; Table 6.3), but are not completely identified due to their inadequate representation in site deposits.

A single conifer, pine (Pinus sp.; Table 6.3), was recovered from the proveniences sampled at En Bas Saline. Conifers are not typically found in Caribbean

archaeobotanical assemblages. With this in mind, the possibility was considered that the carbonized pine specimens from En Bas Saline derived originally from the ill-fated Santa Maria, parts of which were salvaged to build the fortification La Navidad (and which subsequently burnt to the ground some time after Columbus left the area in 1492). However, the weight of the evidence is against the wood having come from the Santa Maria.

Anatomical inspection places the pine specimens within the section Diploxylon (hard pine group) by virtue of the presence of pineoid cross-field pitting and dentate ray tracheids (Figure 6.5). Both features are found in certain Old World pines, however they occur also in native Caribbean pines (Phillips 1941). The archaeological specimens belong to one of three dentate-pine groups, specifically, the sula, ponderosa, or taeda group, based on Phillips's (1941:293-294) anatomical classifications. Of these, the taeda group most closely fits the anatomy of the archaeological specimens. Taeda-group pines are characterized by strongly dentate to reticulate tracheid wall thickenings (which is the form of the dentations in the archaeological specimens [Figure 6.5]), cross-field pits in groups of 3-6 (pit groups of 2-5 were observed in the archaeological specimens [Figure 6.5]), and sparce tangential wall pitting (no such pits were observed in the archaeological specimens). In contrast, the sula group of pines has inconspicuously dentate trachied walls, and pits in groups of 1-4 per cross field; ponderosa

Figure 6.5. *Pinus* sp. wood from En Bas Saline: radial view showing ray tissue with dentate ray tracheids and pineoid cross-field pitting.



pines have tracheids with moderate dentations and, likewise, cross-field pits in groups of 1-4.

Pinus occidentalis Sw. (West Indian pine)--in the taeda group--is very probably the source of the archaeological material. Since the taeda group of pines consists almost, if not exclusively of American species, the charcoal specimens are more likely to have come from native stands of trees than from Columbus's ship. Moreover, while pine charcoal was recovered in five samples from En Bas Saline, at least two of the samples date exclusively to the prehistoric occupation and could not, therefore, derive from European species. West Indian pine is restricted to Hispaniola and eastern Cuba, where it may grow at a wide range of elevations, but occurs more commonly at higher elevations (Holdridge 1942; Little and Critchfield 1965:16).

Contextual analysis. Seed identifications from En Bas Saline are listed by their respective sample proveniences in Table 6.4. The identifications, including modern seeds, are listed by individual sample and feature level in Appendix B. Likewise, wood identifications from En Bas Saline are summarized by provenience in Table 6.5, with the individual samples described in Appendix C. Tentative identifications in both the tables and the appendices are designated by parentheses; "++" is intended to convey that a particular item (e.g., palm fiber) is present, but the fragments were not individually counted. Finally, "unidentified soft tissue" is a catchall that includes small fragments of

Table 6.4. Seed and other nonwood identifications from En Bas Saline (by count). (Counts for individual proveniences and modern seeds appear in Appendix B.)

IDENTIFICATION:	GARDEN B (all prehistoric):							
CULTIVATED:	Feat.24 Burial-1	Feat.31 & 31A/B	Feat.33 & 33A	Feat.35 Lv.2	Post-mold1	Post-mold3	Post-mold6	Area 1 all lvls.
cf. Guava		1						
Maize/Indian corn	1	2	2(3)					
cf. Manioc tuber		(3)+	2(5)					
Palm hard seed coat								
Palm, fiber/?bud			3 ?bud					
Pepper/pimiento								
Primrose		1(2)						
cf. Soursop			1					
cf. Sapotaceae seed		3						
WILD:								
Amaranth./Chenopod.	1							1
Goosefoot family			1					
cf. Inga/guaba		4	4					
Nightshade family								
Panicoid grass		5	15					
Purslane	1	29	7					4
Trianthema	1	5(6)		2				
cf. Grass family								
Legume, wild (seed)								
Legume, wild (fruit)								
Mallow family								
cf. Myrtaceae		1						
Yellow stargrass								
Unid. seed-type 1								
Unid. seed-type 2			1					
Unid. seed-type 3		5						
Unid. seed-type 4								
Unid. seed-type 5		2						
Unid. soft tissue	3	199	93			6		33
ARCHAEO. SEED TOTAL:	5	65	60	2	0	0	0	5

Table 6.4--continued.

IDENTIFICATION:				GARDEN C prehist.:			historic:	
	Area 3A Lv.1	Area 3B Lv.1	Area 4 Lv.2,4	Feat.10 Lv.1	Feat.11 all lvls.	Feat.15 & 15A/B	Zone 1 Lv.2	Zone 2 Lv.1
CULTIVATED:								
cf. Guava								
Maize/Indian corn					23(10)	1		
cf. Manioc tuber		(1)			720	14(33)		
Palm hard seed coat					(1)		1	
Palm, fibrous tissue								
Pepper/pimiento								
Primrose			1					1
cf. Soursop								
cf. Sapotaceae seed					2			
WILD EDIBLE:								
Amaranth./Chenopod.								
Goosefoot family			2					
cf. Inga/guaba					1			
Nightshade family								
Panicoid grass								
Purslane			5					
Trianthema			1				9	
cf. Grass family			3					
Legume, wild (seed)							2	
Legume, wild (fruit)								
Mallow family								
cf. Myrtaceae								
Yellow stargrass			2					
Unid. seed-type 1								
Unid. seed-type 2								
Unid. seed-type 3								
Unid. seed-type 4								
Unid. seed-type 5								
Unid. soft tissue	2	5	12	2	379	46		
ARCHAEO. SEED TOTAL:	0	1	14	0	46	2	12	1

Table 6.4--continued.

IDENTIFICATION:	GARDEN E prehist.: Feat.26 Lv.4	Feat.47A Lv.1	Feat.49 all lvls.	Zone 3 Lv.5	Area 6 FS3746	late preh./contact: Feat.14 & 14A/B/C	Feat.16 Lv.3	Feat.25 Lv.1
CULTIVATED:								
cf. Guava						2		
Maize/Indian corn						1(1)		3(1)
cf. Manioc tuber	(3)		29(40)	(2)	6	1(9)		(3)
Palm hard seed coat								
Palm, fibrous tissue								
Pepper/pimiento		5						
Primrose		1				244		
cf. Soursop								
cf. Sapotaceae seed								
WILD EDIBLE:								
Amaranth./Chenopod.		1				2		
Goosefoot family						1		1
cf. Inga/guaba						3		
Nightshade family						1(1)		
Panicoid grass								
Purslane								
Trianthema						18		
cf. Grass family								
Legume, wild (seed)						1		
Legume, wild (fruit)						3		
Mallow family						2		
cf. Myrtaceae								
Yellow stargrass								
Unid. seed-type 1		1						
Unid. seed-type 2		1						
Unid. seed-type 3								
Unid. seed-type 4			1					
Unid. seed-type 5								1
Unid. soft tissue		17	12	2		23	3	7
ARCHAEO. SEED TOTAL:	0	11	1	0	0	285	0	6

Table 6.4--continued.

IDENTIFICATION:	Area 3 ash	Area 20 Lv.1	historic: Feat.4 (F.4-6-8)	Area 1 all lvls.	Zone 2 Lv.1	PLANT TOTAL	PLANT UBIQUITY
CULTIVATED:							
cf. Guava						3	7
Maize/Indian corn	2(1)	1(2)		2(2)		59	34
cf. Manioc tuber			(2)			827++	41
Palm hard seed coat						2	7
Palm, fibrous tissue					1 ?bud	++	
Pepper/pimiento		1				6	7
Primrose				1	1	251	24
cf. Soursop						1	3
cf. Sapotaceae seed						5	7
WILD EDIBLE:							
Amaranth./Chenopod.						5	14
Goosefoot family		1				6	17
cf. Inga/guaba				1		13	17
Nightshade family						2	3
Panicoid grass					1	21	10
Purslane						46	17
Trianthema			2		3	42	27
cf. Grass family						3	3
Legume, wild (seed)						3	7
Legume, wild (fruit)						3	3
Mallow family						2	3
cf. Myrtaceae						1	3
Yellow stargrass						2	3
Unid. seed-type 1						1	3
Unid. seed-type 2						2	7
Unid. seed-type 3						5	3
Unid. seed-type 4						1	3
Unid. seed-type 5			1			4	10
Unid. soft tissue	12	32		24	11		
ARCHAEO. SEED TOTAL:	5	6	3	5	6		

Table 6.5. Wood identifications for En Bas Saline (relative frequency; values in parentheses are provisional; figures for individual samples appear in Appendix C).

IDENTIFICATION:	GARDEN B (prehistoric): Feat.24 Bur.01 FS6989	Feat.31 4 lvls	Feat.31A Lv.1 FS7199	Feat.33 2 lvls	Post-mold-3 FS7443	Area 1 3 lvls	Area 3A Lv.1 FS7334	Area 3B Lv.1 FS7335
MANGROVE ASSOCIATION:								
Black mangrove	.50	.84	.76	.61		.75	.55	.60
Buttonwood	.50	.08	.10	.22		.14		
cf. Buttonwood (satinwd)								
Red mangrove		.06	.10	.04	1.00	.07		
Red mangrove family								
POSSIBLE HOMEGARDEN:								
cf. Genip							.22	
cf. Inga/guaba		.01						
Myrtle fam., guava/stopper								
Palm		.01		.09				
Sapotac., bullet-wood								
Sapotac., bustic/caimito						.02		
OTHER:								
Boxwood								
Jagua/W.I. boxwood								
cf. Laurel family								
Monkey pistol								
Pine, Haitian			.03					
Poison wood/spicewood								
cf. Snake-bark								
cf. Stopper								
Sweetwood/satinwood								
cf. West Indian elm								
En Bas Saline-10 fig/genip								
En Bas Saline-15 bk. torch							.22	
Unid. liana-like wood								.40
Unidentified hardwood				.04		.02		
TOTAL WOOD TYPES:	2	5	4	4	1	4	3	2
TOTAL NUMBER IDENTIFIED:	2	101	30	23	1	56	9	5

Table 6.5--continued.

IDENTIFICATION:	Area 4 Lv.4 FS7512	GARD.C Feat.15 Lv.4	GARDEN E Feat.47A Lv.1 FS7372	prehist.: Feat.49 5 lvls	Feat.49 PM-10 FS7588	Area 6 Lv.1 FS3888	Zone 3 Lv.5	contact: Area 6 Lv.2 FS6863	Area 6 Lv.5 FS6880
MANGROVE ASSOCIATION:									
Black mangrove	.87	.55	.77	.52	1.00	.62	.55	.17	.53
Buttonwood	.12		.07	.26		.12	.15	.17	.18
cf. Buttonwood									.02
Red mangrove		.25	.13	.16			.11	.12	.04
Red mangrove family									
POSSIBLE HOMEGARDEN:									
cf. Genip									
cf. Inga/guaba				.01			.04		
Myrtle family				.02					
Palm				.01				.17	.04
Sapotac., bullet-wood									
Sapotac., bustic/cai.		.15		.01					
OTHER:									
Boxwood							.04		
Jagau/W.I. boxwood									
cf. Laurel family									
Monkey pistol							.04	.06	
Pine, Haitian			.03						.08
Poison wood/spicewood									
cf. Snake-bark				.01					.06
cf. Stopper		.02						.06	
Sweetwood/satinwood									
cf. West Indian elm									
En Bas Saline-10									
En Bas Saline-15									
Unid. liana-like wood									
Unidentified hardwood		.02		.01		.25	.07	.24	.04
TOTAL WOOD TYPES:	2	5	4	8	1	2	6	7	7
TOTAL NO. IDENTIFIED:	8	40	30	112	30	8	27	17	49

Table 6.5--continued.

IDENTIFICATION:	Area 6 Lv.6 FS6882	Area 6 Lv.7 FS6884	Feat.7 2 lvls	Feat.14 2 lvls	Feat.14A Lv.1 FS7020	Feat.14B 2 lvls	Feat.14C 2 lvls	Fea.25 2 lvls	Ar.3 ash 7040
MANGROVE ASSOC.:									
Black mangrove	.46	.52	.68	.50	.94	1.00	.25	.61	.62
Buttonwood	.31	.04	.16	(.16)			.25	.26	.09
cf. Buttonwood	.23	.16	.05						
Red mangrove				.16	.06		.25		.05
Red mangrove family									
POSSIBLE HOMEGARDEN:									
cf. Genip				.16					
cf. Inga/guaba								.04	
Myrtle family								.02	
Palm		.03					.25		
Sapotac., bullet-wood		(.01)							
Sapotac., bustic/cai.								.02	
OTHER:									
Boxwood									
Jagau/W.I. boxwood			.05						
cf. Laurel family									
Monkey pistol									
Pine, Haitian		.01							
Poison wood/spicewood									
cf. Snake-bark									.09
cf. Stopper		.18							
Sweetwood/satinwood								.04	
cf. West Indian elm									.14
En Bas Saline-10		.01							
En Bas Saline-15									
Unid. liana-like wood									
Unidentified hardwood		.03	.05						
TOTAL WOOD TYPES:	3	8	4	4	2	1	4	6	5
TOTAL NO. IDENTIFIED:	13	75	19	6	16	6	4	46	21

Table 6.5--continued.

IDENTIFICATION:	Area 20 Lv.1 FS7035	Zone 1 Lv.3 FS3797	historic: Zone 2 Lv.1 FS7037	Feat.4 8 lvls	Feat.6 5 lvls	Feat.6 Lv.10	Feat.8 5 lvls	P.M.15 FS3911	Ar.4 3865	UBI-QUITY
				-------	-------	--pit 4-6-8--	-------	-------	-------	
MANGROVE ASSOCIATION:										
Black mangrove				.32	.48		.15		.61	81
Buttonwood				.12	.10	1.00	.25		.05	67
cf. Buttonwood				.22	.11		.20		.05	14
Red mangrove				.04	.14		.05		(.05)	57
Red mangrove family				<.01						5
POSSIBLE HOMEGARDEN:										
cf. Genip										9
cf. Inga/guaba				<.01	.03					24
Myrtle family										9
Palm	1.00			.07						33
Sapotac., bullet-wood				<.01						9
Sapotac., bustic/cai.		1.00								24
OTHER:										
Boxwood				.02					.17	9
Jagau/W.I. boxwood				<.01	.01					9
cf. Laurel family				.02	.01					5
Monkey pistol				.01			.10			14
Pine, Haitian							.05			19
Poison wood/spicewood								.80(.93)		5
cf. Snake-bark				.02						19
cf. Stopper										9
Sweetwood/satinwood										5
cf. West Indian elm										5
En Bas Saline-10				.02						9
En Bas Saline-15										5
Unid. liana-like wood										5
Unidentified hardwood			1.00	.10	.11		.20	.07	.05	
TOTAL WOOD TYPES:	1	1	1	14	7	1	6	1	5	
TOTAL NO. IDENTIFIED:	6	2	1	399	79	1	20	15	18	

amorphous, carbonized non-woody tissue (for example, wood exudate or bits of parenchymatous tissue).

The entire spectrum of domesticated and homegarden/edible plants from En Bas Saline occurs in prehistoric levels at the site (Table 6.4), thus documenting the presence in the Caribbean islands of important economic plant species prior to the entry of Europeans into the region. Oenothera is listed with the cultivated plants, recognizing its possible role as a tended, homegarden species. Garden B contexts and prehistoric components from Gardens C and E yielded maize and tuber fragments, the latter seem to be primarily from manioc plants (see below). Maize and tuber (manioc) fragments are particularly conspicuous in the Feature 11 and 15 deposits (Table 6.4) that are believed to have developed through communal feasting or ritual activity. Sweet potato also may be present in the large communal features.

Aside from being among the most frequent plant remains (Table 6.4), the overall ubiquity values (percent presence in site deposits) for the plant staples--maize and tuber fragments--is relatively high, at 34% representation for maize and 41% for tuber fragments (Table 6.4). Focusing on the strictly prehistoric contexts from Gardens B, C, and E, results still in relatively high ubiquity values for maize and tubers, at approximately 25% for the former and 47% for the latter. These data strongly suggest the importance of domesticated plants to the inhabitants of the site.

Similarly, _Oenothera_ is fairly conspicuous among the site deposits tested, with 251 seeds appearing across 24% of the contexts analyzed. _Oenothera_ seeds are particularly abundant in the post-contact period Feature 14 (244 seeds; Table 6.4). En Bas Saline provides the best evidence for _Oenothera_'s presence at the sites analyzed thus far from the Caribbean islands. As previously stated, the genus no longer occurs on Hispaniola, or on Puerto Rico and the Lesser Antilles.

Likewise, trianthema has its greatest representation in the samples from En Bas Saline (27% ubiquity; Table 6.4). Otherwise, trianthema has been documented from Krum Bay, St. Thomas (seven proveniences, 28 seeds [Pearsall 1983]), and from Maisabel, Puerto Rico (one seed). At Krum Bay uncarbonized trianthema seeds also were recovered, but with two exceptions the 28 carbonized seeds came from relatively deeply buried deposits and all are considered relevant to the archaeological occupation (Pearsall 1983). At En Bas Saline, trianthema, like _Oenothera_, is most conspicuous in the contact-period Feature 14 (18 seeds; Table 6.4).

From the frequencies and ubiquity values at the end of Table 6.4 it is clear that edible plants, including homegarden types, are more abundantly represented in the archaeological deposits at En Bas Saline than are non-edible species. Non-edible types are present in much lower numbers and appear in fewer proveniences (Table 6.4). This strongly suggests that the remains of the edible plants in En Bas

Saline deposits are indeed present as a result of direct associations with the site's inhabitants, rather than merely existing as opportunistic weeds that grew in the vicinity of the hearths and other contexts by which they could have become accidentally carbonized. Conversely, the minor representation of non-edible species (each appearing in but a single or no more than two proveniences) suggests that their presence is inconsequential to economic activities at the site. Thus stargrass and possibly also unknown seed types 1-4 are probably irrelevant to the archaeological occupation. Unknown number 5, however, may have had some economic value, based on its greater site representation (10% ubiquity). Unknown number 5 actually may not be a seed type, since all the specimens lack seed coats. Rather, this category of plant material is very similar to what was tentatively identified as fragments of cassava bread from deposits at Trunk Bay, St. John. Based on the present evidence, therefore, and combining clearly and apparently used plants, at least fourteen types of edible or otherwise useful plants are represented in the seed/non-wood remains from En Bas Saline.

Wood remains from En Bas Saline are only minimally discussed here to stay more narrowly focused on subsistence and economy, reserving more detailed analyses of wood products and wood explotation for subsequent writings. As described above, at least 20 different types of wood were recovered. The wood identifications add to the list of

possible homegarden species represented at the site, with the provisional identification cf. genip and with the type bustic/camito. Three wood types, to the extent the identifications are correct, apparently also are present among the seed remains, including palm, cf. guaba, and cf. guava.

Table 6.5 shows the distributions of the various wood types across the site. One or more mangrove species are present in nearly every context sampled. Mangrove wood appears as frequently in prehistoric- as in historic-aged deposits. Black mangrove is most conspicuous of the wood types, occurring in 81% of the contexts sampled. Buttonwood is nearly as frequent, appearing in 67% of the samples (cf. buttonwood specimens are nearly identical, but differ by virtue of the vascular rays which are weakly, rather than strongly heterocellular, but not necessarily indicative of a distinct wood type). Red mangrove appears in slightly more than half the samples analyzed (Table 6.5).

Palm wood is fourth in frequency of occurrence at En Bas Saline, followed by cf. guaba and bustic/caimito. All other wood types occur in four or fewer proveniences. Five of the woods (bullet-wood, jagua/West Indian boxwood, sweetwood/satinwood, cf. West Indian elm, and EBS-10) apparently occur exclusively in latest prehistoric to contact-period samples; the woods cf. laurel family and poison-wood/spicewood have been identified only from historic Feature 4-6-8.

One final note on the wood remains: a disproportionately large number of specimens from Feature 4 (Feature 4-6-8; Table 6.5) were identified and/or classified. The reason for so great a number identified is the search for the possible presence of European woods that might have been part of the _Santa_ _Maria_ (i.e., evidence that would help to verify the location of _La_ _Navidad_). With the possible exception of the pine described above, temperate or other exotic woods have not been encountered in the samples analyzed from En Bas Saline.

Individual taxonomic treatments. Certain of the plant remains from En Bas Saline merit closer inspection and analysis to bring finer resolution to the identifications. Among the plant remains treated in greater detail below are 1) maize; 2) manioc (tuber remains in general); 3) pepper; 4) panicoid grass; and 5) _Oenothera_ sp. (evening primrose). Maize, manioc, and pepper obviously are designated for closer scrutiny because of they are among the most important, earliest, and widespread of native American domesticated plants. Likewise, Panicoid grass is given special treatment because members of the subfamily Panicoideae have a long association with human groups (Harlan 1975; Prasada Rao et al. 1987). In particular, archaeobotanical evidence from the Tehuacan region of Mexico demonstrates that the genus _Setaria_ was manipulated by human groups--the net effect was an increase in seed size (Callen 1965, 1967a; C.E. Smith 1967)--prior to the advent of

widespread use. Finally, Oenothera is among the group of plants from En Bas Saline examined in greater detail because of its interesting range extension and potential economic value.

Maize. Maize specimens were recovered from ten distinct deposits at En Bas Saline, spanning the full temporal sequence of site occupation (ca. A.D. 1250 to ca. A.D. 1510). All together, 16 archaeobotanical samples (22% of the flotation/fine-sieve samples) produced maize remnants (some of these are multiple samples from the same deposits; Appendix B). Table 6.6 summarizes the maize from En Bas Saline by context and by the particular category of maize specimen.

Included in the maize assemblage are 8 whole or nearly complete kernels, 1 cob fragment, 28 separated cupules, and 20 additional tentatively identified specimens of kernel and cupule fragment (Table 6.6). All specimens are thoroughly carbonized.

All of the maize from En Bas Saline came from discrete structural deposits or pits. Maize-bearing contexts include the large prehistoric feasting pits in the plaza area (Features 11 and 15), the prehistoric structure on the raised earthwork encircling the northern portion of the site (Garden B, Features 31 and 33), the large chiefly structure/mounded area in the central plaza (Features 14, 25; Areas 1, 3, 20), and the Garden B dog burial (Feature 24) (Table 6.6). In contrast, no maize was encountered in

Table 6.6. Zea mays from En Bas Saline, Haiti.

Provenience	Date	Notes
FEATURE 11, level 3 (FS 6312)	1350+-70	1 popcorn kernel; 1 flour-type kernel fragment
FEATURE 11, level 4 (FS 6313)	1350+-70	3 cupule fragments; 3 ?kernel fragments
FEATURE 11, level 5 (FS 6316)	1350+-70	1 popcorn kernel; 1 flour-type kernel; 2 ?kernel; 12 cupule fragments (2 nearly complete); 1 ?cupule fragment
FEATURE 11, level 6 (FS 6318)	1350+-70	3 cupule fragments; 4 ?cupule fragments
FEATURE 11, all lvs. all levels (FS 6317)	1350+-70	1 cob fragment with a portion of a single rank preserved.
FEATURE 15B, Area 6 (FS 6773)	1350+-70	1 cupule fragment
FEATURE 14, level 3 (central structure) (FS 6903)	1410+-60 1440+-70	1 ?kernel; 1 cupule fragment
FEATURE 25, level 1 (central structure) (FS 7017)	1410+-60 1440+-70	1 flour-type kernel; 1 kernel, ?flour-type; 1 kernel fragment; 1 ?cob fragment
AREA 20, level 1 (central structure) (FS 7035)	1410+-60 1440+-70	1 cupule; 2 ?kernel
ASH AREA 3 (central structure) (FS 7040)	1410+-60 1440+-70	2 cupules, 1 ?kernel fragment

Table 6.6--continued.

Provenience	Date	Notes
FEATURE 31, level 2 (small structure) (FS 7198)	(prehist.)	1 kernel fragment; 1 ?kernel fragment
FEATURE 33A, level 1 (small structure) (FS 7216)	(prehist.)	2 cupule fragments; 3 ?cupule
FEATURE 24 dog burial (FS 6989)	(late preh. or contact)	1 cupule
AREA 1, Garden E (FS 3745)	historic	2 cupule fragments; 1 fragment monocot stem (? maize stalk)

samples from the zonal sheet deposits that represent gradual refuse accumulation at the site. It should be noted, however, that few such samples were analyzed.

More than half of the maize specimens from En Bas Saline--including the only cob fragment--came from Feature 11 (Table 6.6). All but three (Features 24, 31, and 33) of the remaining samples came from floor and wall deposits in the large, burned structure on the central mound

Morphological analysis of the maize specimens provides some insight into the types of maize grown by the Taino who occupied En Bas Saline. Preliminary racial classifications based on grain morphology and cob characters were verified in May 1990 by Dr. Walton Galinat, an expert on maize and maize evolution, who briefly examined the kernels and cob fragment. Variation in kernel morphology demonstrates that at least two types of maize were present at the site. The kernels partition by size, shape, and texture into two, possibly three, groups: the first is comprised of flat-topped, somewhat cylindrical, or peg-shaped kernels (Figure 6.6); a second group consists of short, crescent-shaped kernels (Figure 6.6); and a third possible morphology is recognized based on the presence of a single, relatively large kernel (Table 6.7) that is generally crescent-shaped, but taller and more angular in outline than the other crescent-shaped specimens. From the archaeology it is clear that all three maize kernel morphotypes were present at En Bas Saline prior to historic contact (Table 6.6).

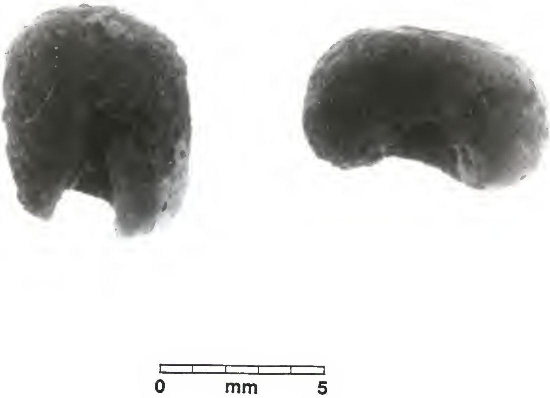


Figure 6.6. <u>Zea mays</u> kernels from En Bas Saline, Field Sample 6316 (left is popcorn type, right is flour type).

Table 6.7. Zea mays measurements* (mm) for En Bas Saline, Haiti. (Measurement D1 is distance form the base to the widest part of the kernel [King 1987].)

SPECIMEN	CONDITION	COB length	ALI-COLE length	CUPULE thick-ness	CUPULE W.E.	CUPULE W.I.	CUPULE W.W.	CUPULE L.E.	CUPULE L.I.	CUPULE depth	LOWER GLUME width	SPIKE-LET thick.
COB:												
6317 cob fragment	3 alicoles, 1 is intact	8.95	3.60	1.30	6.05	4.25	1.12	2.15	1.55	1.00	3.40	1.10+-
CUPULES:												
6316 #1	wing +- broken			2.45	8.0+	6.50				2.50		
6316 #2	wing +- broken			1.75	6.9+	5.80				1.50		
7040 #1	nearly complete			1.65	5.15	3.15						
7040 #2	nearly complete			2.10	5.10	3.30						

KERNEL:		Kernel height	W.M.	W.P.	W.D.	Thick. mid-sect.	D1
6312 pop	nearly complete, split in two	6.80	6.20	4.20	6.10	4.05	5.30
6312 flour	upper portion	-	6.80	-	-	4.85	-
6316 pop	nearly complete	6.90	5.40	4.90	5.00	5.10	5.35
6316 flour	nearly complete	4.20	7.25	-	-	5.70	1.90
7017 flour	upper half	-	7.40	-	-	6.35	-
7017 ?flour	nearly complete	7.90+	6.90	-	-	4.45	4.30

*L.E. = length, exterior; L.I. = length, interior; W.D. = width, distal; W.E. = width exterior; W.M. = width, midsection; W.P. = width, proximal; W.W. = width, wing.

Two peg-shaped kernels from the Feature 11-communal hearth were examined by Dr. Galinat who concluded that they represent a popcorn type of maize (Figure 6.6). At least two additional kernels from the feature belong, according to Dr. Galinat, to a second type of maize, specifically, a floury-endospermed race (the crescent-shaped kernel morphotype). This type of maize may have been grown to produce grain suitable for grinding into meal and flour, although other uses (see below) are indiciated by the ethnohistoric record. At least one additional specimen of the flour-type of kernel was recovered from a separate provenience, specifically, Feature 25 (FS 7017, the large burned structure on the central mound) (Table 6.6). The third potential kernel morphotype--the large, angular specimen (Table 6.7)--also was recovered from Feature 25.

All kernel specimens from En Bas Saline are relatively smooth surfaced (non-dent). However, two kernels from Feature 11--one is the peg-shaped type (FS 6312) and the other is one of the crescent-shaped kernels (floury endospermed type) (FS 6316)--have slightly depressed, circular roughened areas on their upper-most surface. The differently textured area may represent spalling of the testa from carbonization. Alternatively, the roughened area at the kernel peaks may represent the small capping of soft starchy deposit that generally characterizes kernels from West Indian races of maize (Brown 1953:149). The maize kernel specimens from En Bas Saline are small and at least

superficially similar to archaeological specimens, including popcorn, from northern South America (Pearsall 1990; Roosevelt 1980) and Belize (Miksicek et al. 1981).

The En Bas Saline cob fragment is small, possessing but a single complete alicole that is bordered by two partially intact alicoles of the same rank (Figure 6.7). Glumes are present, but the distal portions are broken away. Only a small portion of the cob's rachis tissue survived the ravages of time. Nevertheless, it was possible to record a few cob measurements (Table 6.7). Additional metric data from loose cupules (n=4) supplement those from the cob section (Table 6.7). The cob and cupule measurements seem to indicate a relatively small-cobbed race of maize, consistent with the generally fine scale of the kernels from the same deposit.

It is difficult or impossible to determine the exact races and appearance of the archaeological maize from En Bas Saline, based on the small sample from the site. Seven extant races of maize are known from the Caribbean Islands (Bretting et al. 1987; Brown 1953, 1960; Brown and Goodman 1977; Hatheway 1957): Cuban Flint, Haitian Yellow, Coastal Tropical Flint, Chandelle, Tuson, Early Caribbean, and St. Croix. St. Croix, a recently derived hybrid between West Indian maize and maize from the southeastern United States, is not further considered here. Published comparative metric data from the other six West Indian races are presented in Table 6.8.

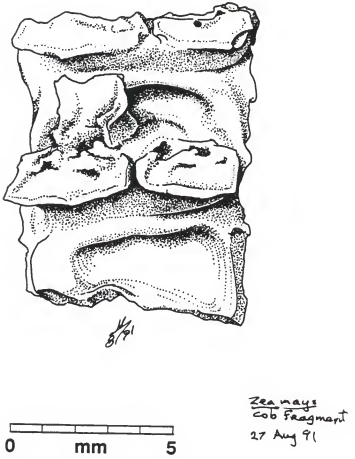


Figure 6.7. Zea mays cob fragment from En Bas Saline (Field Sample 6317).

Table 6.8. Descriptive data for West Indian races of maize (mean measurments in millimeters).

RACE*	CF	HY	CTF	Ch	TU	EC
Ear length	17.4	18.4	21.0	19.6	21.6	18.0
Cob diameter:						
basal	48.0	46.5	46.8	31.8	54.4	43.8
mid-ear	44.2	40.2	45.6	33.2	51.9	40.7
shank	16.7	18.2	18.1	9.8	18.6	14.8
Row number:						
range	12-16	8-14	12-18	12-16	12-16	8-14
mean	14.2	11.1	14.7	12.5	13.4	11.6
Kernel:						
width	8.8	9.4	8.7	7.0	10.0	9.4
length	9.4	9.4	9.2	10.7	11.8	9.4

*CF = Cuban Flint; HY = Haitian Yellow; CTF = Coastal Tropical Flint; Ch = Chandelle; Tu = Tuson; EC = Early Caribbean; St. Croix race excluded, as a recent hybrid.

Maize measurements are adapted from Brown (1953).

It is worthy of note that the kernal morphology typifying the race of maize known as Early Caribbean (Tables 6.8, 6.9) conforms with the cresent-shaped, flour-type specimens from En Bas Saline (Table 6.7). Early Caribbean kernels tend to be crescent-shaped and are about as wide as long (Brown 1953:159). This description fits reasonably well with at least three kernels from En Bas Saline (Figure 6.6; Table 6.7). Average kernel height and width for Early Caribbean both are 9.4 mm (kernel height range 9-11 mm; width range 8-11 mm) (Brown 1953:162). These dimensions exceed corresponding morphometric data from the archaeological kernels (Table 6.7), but the distortive effects on size that result from carbonization must be considered with regard to the archaeological specimens. Rather than shrinkage, most replication studies document kernel expansion in conjunction with the carbonization process (general estimates are of a 3-10% increase in kernel height and width [Goette 1990; King 1987:133-136]). Nevertheless, depending on the extent and duration of heating, the opposite effect (shrinkage) may occur. The En Bas Saline kernal sample currently is too limited to assess the effects of carbonization.

Interestingly, botanists have for some time suspected that Early Caribbean is an indigenous race with a long ancestry in the islands (Brown 1953, 1960; Brown and Goodman 1977). Brown (1953) summarized Early Caribbean, concluding that the race was not closely related to any known maize of

Table 6.9. General morphological characteristics of kernels from West Indian races of maize.

Cuban Flint

Kernels are short, varying from flat-topped to slightly pointed. Kernels (pericarp) are colorless (white); endosperm is intense orange-yellow.

Haitian Yellow

Kernels are about as wide as long; they are widest at midpoint and are strongly pointed. Grains vary from flint to somewhat dented, usually with a slight capping deposit of soft starch. Kernels color is bronze to red; endosperm yellow to white.

Coastal Tropical Flint

Kernels tend to be only slightly longer than wide and weakly pointed; not a true flint as kernels tend to have a small but distinct capping of soft starch at the apex of the kernel. Kernel color lacking or occasionally with reddish tinge; endosperm color deep yellow.

Chandelle

Kernels of a semi-flint form are long and narrow; widest about two-thirds from the base to the tip of the kernel, and slightly pointed. Most grains are capped with a small deposit of soft starch. Kernels belonging to a dent form are not pointed and contain a higher proportion of soft starch. Kernel color generally lacking (white), sometimes reddish; endosperm yellow.

Tuson

Kernels are not pointed and are conspicuously capped with a deposit of soft starch. Kernel color lacking (white); endosperm yellow to orange.

Early Caribbean

Kernels are semi-flint, about as wide as long, and are frequently crescent-shaped. Little denting is present, despite the presence of a small deposit of soft starch at the distal end of the kernel. Kernel color generally red or reddish; endosperm yellow.

Source: Brown (1953); Brown and Goodman (1977).

either Central or South America, and, further, that there was nothing to indicate that Early Caribbean was a recent introduction into the Caribbean archipelago. According to Brown (ibid.), "Historical evidence . . . suggests it [Early Caribbean] to be a remnant of one of the earliest types introduced into Europe and must, therefore, have been in the West Indies at the time of or soon following historic contact." If Brown is correct in his assessment of Early Caribbean, then possibly the flour type of maize from En Bas Saline, which has similarly shaped kernals, could be directly ancestral to the modern race. The earliest maize to travel to Europe is thought to have been carried on Columbus's first return voyage (Hatheway 1957). If En Bas Saline is correctly identified as the site of Columbus's La Navidad, then indeed, the maize grown by the site's Taino inhabitants could have been among the first specimens sent to Europe along with other plant and animal curiosities (Crosby 1972).

More recently, enzymatic studies have helped to further clarify Early Caribbean's status. Bretting et al. (1987) demonstrated that even though it is phenotypically distinct from other West Indian races of maize, Early Caribbean's isozyme complement is very similar to three separate Caribbean races. They then proceeded to interprete the isozymatic and morphological data as an indication that Early Caribbean may be a relictual form of an indigenous race.

According to Brown (1953), Early Caribbean is a short season maize, which seems to agree with Oviedo's (1959) observation that corn harvests in the sixteenth-century took place within three to four months after the initial planting. Early Caribbean ears are medium length (18 cm) with 8-14 rows of semi-flinty grain (Brown 1953). The kernels are described (ibid.) as being about as wide as long and frequently crescent-shaped with "little denting, despite the presence of a small deposit of soft starch at the tips of the kernels." Thus, the flour kernel morphology from En Bas Saline (Figure 6.6) conforms with Brown's description of at least one indigenous race of maize, perhaps even to the extent that the circular, roughly textured area at the distal end of the kernel from Feature 11 (described above) may agree with the starch deposits at the tips of some kernels.

The popcorn (peg-shaped) type of kernel from En Bas Saline agrees with the description of kernels for the race known as Chandelle (Table 6.9), in which the kernels are widest near the distal end. This is not to exlude the other races from consideration, however, since their associated kernel morphologies currently are not clearly enough defined (more comparative data are needed). Only Haitian Yellow, with its strongly pointed kernels, is excluded as the source of kernels from En Bas Saline.

Manioc and other tuber types. One distinctive class of plant remains from En Bas Saline consists of carbonized

plant fragments that are composed almost entirely of soft parenchymatous tissues, including, in some cases, periderm. Fortunately, several fragments represent nearly complete plant organs, or the distal portions thereof. These are clearly discernable as storage structures (Hather 1991:673), specifically, the remnants of rootstock or tubers (Figure 6.8). The specimens shown in Figure 6.8 come from prehistoric Feature 11 (lower right; FS 6317), Garden C, and from Area 6 (FS 3746) of Garden E (all specimens exclusive of the one on the lower right). Additional specimens were recovered from Garden B Features 31 and 33, and Area 3B; Feature 15, Garden C, produced at least 14 tuber fragments, and there may be 33 more (Table 6.4); finally, Features 26, 49, 4-6-8, 14, and 25, and Zone 3 of Garden E (Table 6.4) contained additional tuber remains. Feature 11, the hypothesized communal hearth, produced the greatest quantity of tuber fragments, with over 700 identified (Table 6.4).

The tuber fragments are relatively small, with an average diameter of 14.21 mm (range 7.28-18.91 mm) and average length of 26.24 mm (range 22.92-35.47 mm) (n=17). Those that are whole or nearly so are broadest at about midsection, becoming constricted at the ends (Figure 6.8). The shape and small size of the tuber specimens from En Bas Saline are reminiscent of small, "discard" tubers that have been recovered from archaeological sites in Peru (Ugent et al. 1986:95). Whole manioc tubers from the Casma collection, Peru, are 7 cm or less in length and are

Figure 6.8. Carbonized tubers from En Bas Saline, (lower right is from Field Sample 6317, all others are from Field Sample 3746).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believed to have been disposed of by the inhabitants of various sites due to their small size. Other specimens from the Casma collection appear to represent inedible, woody end-sections that were cut away and cast into hearth fires (ibid.).

The tuber fragments from En Bas Saline can be further described by their external appearance and by anatomy, based on the better-preserved specimens. For the most part, internal structure is lost or greatly distorted by the carbonization process. A few specimens, however, exhibit what appears to be a periderm, or cortical tissue, and, interior of that, a prominent region of starchy parenchymatous tissue. In some cases, there apparently is present also a central vascular region, such as is characteristic of manioc (Manihot spp.) (Onwueme 1978:113). Other specimens seem to exhibit the dispersed vascularization of other tuber types, including sweet potato (Ipomoea batatas) (Esau 1977:250-253; Hayward 1938:498-500; Onwueme 1978). However, distortion renders this latter observation uncertain and inconclusive; it has not been possible to discern any evidence of anamolous secondary growth, such as generally also characterizes sweet potato tubers (Esau 1977:250-253; Hayward 1938:498-500). Nevertheless, by external morphology (see below) sweet potato probably is present. Diagnostic starch granules (Jackson and Snowdon 1990:226-227), which occasionally are preserved in archaeological specimens (Ugent et al. 1986),

have not survived the carbonization process for the specimens from En Bas Saline.

Externally, based on the few examples with intact periderm, the presence of longitudinal ridges or fissures on some specimens was noted, and in a few cases also, transversely oriented (parallel to the ridges) cork cells (or cortical parenchyma) are clearly evident. This periderm structure compares well with comparative specimens of manioc tuber; mature sweet potato also exhibits transversely oriented parenchyma, but the longitudinal ridges are less developed. Other tuber specimens from En Bas Saline are smoother-surfaced, like sweet potato, but this state may be more superficial than real, possibly having resulted from the loss of external tissues during carbonization.

Combining the evidence of size and general appearance, together with external and internal structure, indicates that at least two types of tuber are present. One type possesses rougher, corky external tissues and a central vascular strand. These features compare especially well with manioc. In addition, relatively large fragments (ca. 2-3 cm diameter) of flattened, apparently pulvarized material--in particular from FS 6317, Feature 11--are possibly burnt cassava bread. The other tuber type has dispersed vascularization and somewhat smoother outer tissues. Specimens of this second type (Figure 6.7, center-bottom) are nearly identical with dessicated specimens of archaeological sweet potato from Peru, in terms of size,

shape, and texture (archaeological specimens from Peru were examined during a visit to Dr. Ugent's lab, Southern Illinois University, March 1993). One feature possibly lacking on the En Bas Saline specimens that is well preserved on the Peruvian sweet potato remains is the presence of shoot primordia ("eyes"). However, circular depressions on the surfaces of a few specimens from En Bas Saline (Figure 6.8, center-bottom) may be the remants of burned primordia.

Other types of tuber aside from manioc and sweet potato may be among the fragmentary remains from En Bas Saline, since the Taino are known to have cultivated as many as six additional rootcrops. According to Sauer (1966:53) and Sturtevant (1961, 1969) minor rootcrops in the Caribbean included arrowroot (_Maranta arundinacea_), yautía (_Xanthosoma_ spp.), guinea arrowroot (_Calathea allouia_), yam or aja (_Dioscorea trifida_), and edible canna (_Canna edulis_). Sturtevant (1969:189-192) has suggested that native _Zamia_ sp. also was incorporated into the Taino rootcropping system, based on Las Casas' description of the plant "guayaga" and its use. The possible presence of these additional rootcrops at En Bas Saline necessarily will go undetected until additional archaeological specimens and/or adequate comparative materials are available.

Capsicum pepper. Another important component of Taino gardens was pepper plant(s). Las Casas (in Sauer 1966:57) related that three types of pepper were regularly used by

the Taino, two of which were domesticated and the third of which was wild. One of the domesticates is described as having been red, long, and finger-shaped (e.g. C. annuum); the other was round and smaller, like a cherry, and was more pungent (?C chinensis) (see Pickersgill 1984). The wild pepper reportedly had small fruit, but unfortunately is not further described.

Five pepper seeds were recovered from prehistoric Feature 47A, located in what was the central structure in the plaza area. One additional pepper seed came from nearby Area 20 (Table 6.4), which dates to the contact period.

The pepper seeds from En Bas Saline are carbonized and preserved in such a way that the outermost ring of tissue is present, but the thinner central portions of the seeds are burnt away. The diameter of the seed from Area 20 (FS 7035) is 2.56 mm; four specimens from Feature 47A (FS 7372) measure 2.73 mm, 2.64 mm, 2.68 mm, and 2.38 mm, respectively, in diameter. The average diameter of the five seeds is 2.59 mm, which is smaller than the diameter estimates for Capsicum sp. seeds from Barrio Ballaja (described previously in Chapter 4), which are between 3 and 4 mm. The size of the seeds from En Bas Saline compares closely with an accession of wild Capsicum sp. seeds (C. annuum) from south Florida, with a mean diameter of 2.90 mm (range 2.69-3.33 mm). Seed diameters from domesticated forms of Capsicum consistently exceed 3.5 mm, as was described above in Chapter 4. Therefore, seed diameter

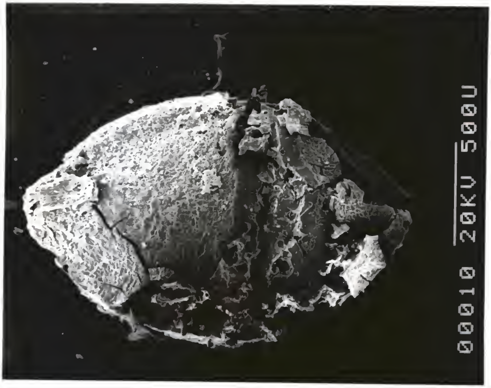
probably excludes the En Bas Saline seeds from consideration as having derived from domesticated Capsicum sp. Nevertheless, a conclusion about the status of the pepper seeds from En Bas Saline is not possible without more data and without consideration of the effects that carbonization might have had on the seeds since considerable shrinkage may have occurred. Thus, the possiblity exists that cultivars are represented among the pepper seeds from En Bas Saline. Until the unknown effects of carbonization are quantified, the seeds from En Bas Saline simply will be regarded under the broader designation pepper, in acknowledgement of the fact that the present analysis is inclusive as to the presence of domesticated versus wild forms.

Panicoid grass. Panicoid grass seeds from deposits at En Bas Saline (Figure 6.9), as well as from several of the sites on Puerto Rico (Chapter 5), may represent natural dispersal of seeds by ruderals. Indeed, at each of the sites the seeds also are represented in the modern seed rain (Appendix B), calling into question the archaeological status of the seeds. Nevertheless, at least one feature from En Bas Saline--Feature 33, and to some extent also, Feature 31 (Table 6.4)--produced panicoid grass seeds in great enough concentration to suggest that the grains may have been utilized by the Taino inhabitants of the site. Furthermore, the association of the grass seeds in Features 31 and 33 with other plant food remains may be an indication of direct use.

Figure 6.9. Panicoid grass seeds from En Bas Saline.

Right Photo: grain from Field Sample 7197, with partial preservation of glumes (upper left corner in photo (48x)

Left Photo: grain from Field Sample 7215 (51x)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Grain size measurements for the grass seed specimens from En Bas Saline in comparison to morphometric data from modern specimens is shown in Table 6.10. These comparative data place the En Bas Saline seeds within the size range of wild grasses (Table 6.10), even considering a shrinkage factor estimated at around 10% due to carbonization (laboratory data; Table 6.10). Even though Callen (1967a:535) did not document the seed size increase for Setaria specimens from Tamaulipas, Mexico, which would give size estimates of wild versus domesticated seeds in a prehistoric assemblage, it seems likely that the En Bas Saline grass seeds were collected from wild populations. More data and additional quantitative comparisons need to be made, however, to confirm this observation.

Oenothera seeds. Seeds from Feature 14A (FS 7020; Figure 6.10) were examined by Dr. Warren Wagner (Smithsonian Institution), who confirmed their identification as Oenothera sp. (section Oenothera, subsection Raimannia, possibly O. humifusa, a coastal species [personal communication, 23 May 1991]). Dr. Wagner verified that the genus has never been collected from Haiti, but has been collected from nearby Cuba. The presence of Oenothera seeds in archaeological deposits from two additional Caribbean islands--Nevis (Chapter 4) and Puerto Rico (Chapter 5)--further documents a previously expanded geographic range for the genus Oenothera. As noted above, the extended range may have been directly influenced by prehistoric human groups.

Table 6.10. Morphometric data from Panicoid grass collections, archaeological* and modern+ populations (mm).

	n=	Mean Length	Stan. dev.	Mean Width	Stan. dev.
1. EN BAS SALINE* (glumes absent)	12	1.48	.22	1.08	.16
2. Horr's Isl., Fla.* (glumes absent)	45	1.52	.22	1.23	.13
3. Tehuacan, Mexico* (with glumes)	-	2.00	-	1.2-1.5	-
4. Setaria sp.+ (Gainesville, Fla.)	20	2.27	.13	1.16	.09
5. same as no.4 with glumes, carbonized	12	2.08	.08	1.02	.13
6. Setaria viridis+ (commercial seeds)	15	2.14	.09	1.31	.06
7. same as no.6 with glumes, carbonized	7	2.16	.27	1.46	.16
8. same as no.6 with glumes removed	4	1.59	.07	1.15	.05
9. S. macrosperma+ (Vero Beach, Fla.)	20	3.06	.11	1.36	.07
10. same as no.9 with glumes, carbonized	8	2.88	.10	1.38	.07
11. same as no.9 with glumes removed	6	1.90	.15	1.19	.08
12. S. macrosperma+ (Sanibel Isl.,Fla.)	12	2.96	.13	1.29	.11
13. same as no.12 with glumes, carbonized	8	2.70	.18	1.18	.07
14. S. faberi+ (commercial seeds)	15	2.69	.13	1.35	.10

Table 6.10--continued.

	n=	Mean Length	Stan. dev.	Mean Width	Stan. dev.
15. same as no.14 with glumes, carbonized	13	2.57	.13	1.40	.14
16. same as no.14 with glumes removed	15	1.82	.14	1.13	.08
17. Panicum ramosum[+] (commercial seeds)	15	3.19	.11	1.86	.08
18. same as no.17 with glumes, carbonized	7	3.11	.12	1.90	.11
19. same as no.17 with glumes removed	7	2.00	.04	1.71	.05

[*]Horr's Island (Newsom 1991); Tehuacan seeds from Coxcatlan and San Marcos caves (Smith 1967:236). Seeds from En Bas Saline and Horr's Island (Florida), with the exception of two mineralized seeds in the latter collection, are carbonized; specimens from the Tehuacan caves are desiccated.

[+]Commerical seeds are from Forestry Suppliers, Inc. All other modern seeds are from spontaneous populations; no. 4 is from a mowed city lot.

Figure 6.10. *Oenothera* sp. (evening primrose) seeds from En Bas Saline, Haiti (Field Sample 7020)

(Right Photo 26x; Left Photo 65x)


70718 20KV 500U

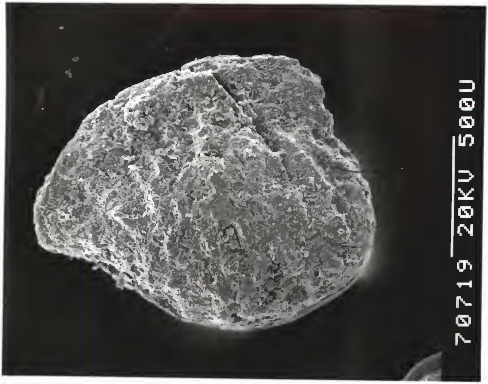
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Figure 6.10 shows three of the Oenothera seeds from Feature 14A; the two elongate specimens are more typical of the entire assemblage, most specimens being about a third as wide as they are long. The same is true of the Oenthera seeds from Nevis and Puerto Rico. Oenothera seeds from En Bas Saline average 1.58 mm long by 0.93 mm wide (Table 6.11). Currently, comparative data are too limited to attempt to assess whether the archaeological populations might represent domesticated plants or some stage of incipient domestication. Dr. Wagner noted that generally the En Bas Saline seeds are relatively small, but that some shrinkage may have occurred in conjunction with carbonization. To the extent the archaeological specimens compare and overlap with the range of measurements from the single modern, wild seed population described in Table 6.11, there is nothing to indicate that the En Bas Saline seeds came from anything other than wild plants. Seed size in itself, however, does not negate the possibility that Oenothera plants were components of homegardens or the general horticultural system at En Bas Saline. The effect on the plants of an association with humans may not be apparent in the seeds themselves, or manipulation may not have been of enough intensity to result in a change in seed size (Rindos 1984).

Before going on in the final sections of this chapter to summarize En Bas Saline, archaeobotanical data from the early contact site of La Isabela are briefly described in

Table 6.11. Oenothera sp. (primrose) seed measurements (mm).

Oenothera sp., archaeological
Sample 7020, En Bas Saline
n = 20

	length	width
Average	1.58	0.93
Minimum	1.35	0.75
Maximum	1.98	1.17
Std. dev.	0.17	0.11
C.V.	11.02	11.87

Oenothera laciniata Hill,
modern seeds (wild)
n = 32

	length	Width
Average	1.33	0.71
Minimum	1.00	0.55
Maximum	1.75	0.90
Std. dev.	0.19	0.09
C.V.	14.23	13.17

modern seeds,
carbonized
n = 12

length	width
1.24	0.71
1.00	0.55
1.50	0.83
0.17	0.08
13.42	10.73

the next few paragraphs. The contexts examined from Isabela date exclusively to the early contact period, as such they are roughly contemporaneous with the latest occupation at En Bas Saline.

La Isabela, Dominican Republic

La Isabela is the site of the earliest Spanish settlement in the New World (Deagan 1992; Veloz Maggiolo and Ortega 1992). A few feature samples from the site were examined for potential evidence of food-plant remains, primarily to assess the nature of plant preservation in conjuction with an overall plan of excavation and research at the site.

Table 6.12 shows the plant samples from Isabela. Even though the samples are few and plant remains sparse, several plants were identified (Table 6.13). Two seed types--goosefoot family and mastic-bully--occur in carbonized form; nevertheless, the goosefoot-type seed seems only to be lightly burnt and so may not be contemporaneous with the archaeological occupation. At least seven other seed types were recovered, but all are clearly modern and presumably intrusive (Table 6.13).

Table 6.14 shows the distribution of the plants from La Isabela. The most interesting of the identifications is mastic-bully, the hard seed coat fragments of which were recovered from two proviences: floor deposts from a structure (FS 5040) and in the burial fill surrounding the remains of a Spanish individual (at least seven seeds).

Table 6.12. Archaeobotanical samples from La Isabela, Dominican Republic. (Two seeds from FS 5304 are not definitively archaeological, being only lightly carbonized and thus, of uncertain status.)

PROVENIENCE	CONTEXT	SAMPLE VOLUME (ltrs.)	SAMPLE WEIGHT (grams)	LT.FRACT. WEIGHT (grams)	WOOD WEIGHT (grams)	WOOD DEN-SITY	WOOD NO. IDEN.	TOTAL SEEDS	ARCH. SEEDS	SEED DEN-SITY
E08/LHN Un.09 Area 1, Lv.3 Nth 1/2 FS 5416	floor	1.50	588.00	-	0.00	-	-	1	0	-
E16/LIN Un.02 1.97-2.15 cm FS 5375	montero	1.10	1098.00	-	0.48	0.4	0	5	0	-
E16/LIN Un.02 Feat.1, Lv.2 1.95-2.00 cm, FS 5304	escudilla	0.60	651.00	-	0.11	0.2	0	10	(2)	3.3
E16/LIN Un.02 Feat.1, Lv.3-4 2.04-2.27 cm, FS 5382	floor	-	-	-	0.79	-	0	5	1	-
E16/LIN Un.14 Feat.1, Lv.4 2.27-2.34 cm, FS 5040	floor	7.60	8031.00	-	1.41	0.18	0	0	0	-
Spanish burial+	burial	-	-	-	0.00	-	0	+	+	-
TOTALS:					2.79			21	3	

+Seeds collected from sediments surrounding human burial; a small sample was furnished, courtesy F.L. Calderon, exact number of specimens is not certain.

Table 6.13. Plant identifications from La Isabela, Dominican Republic.

TAXON	COMMON NAME	PLANT PART
Archaeological:		
Chenopodiaceae	goosefoot family	seed
Mastichodendron foetidissimum	mastic-bully, (tortugo amarillo)	seed
Unidentified hardwood		wood
Unidentified seed fragment		seed
Modern seeds:		
Argemone mexicana	Mexican poppy (cardo santo)	seed
Asteraceae	sunflower family	seed
cf. Asteraceae	sunflower family	seed
cf. Caryophyllaceae	chickweed family	seed
Malvaceae cf. Sida sp.	mallow family	seed
Portulaca sp.	purslane (verdolaga)	seed
Solanaceae cf. Physalis	ground cherry, (alquequenje)	seed
Unidentified seed	small, spherical form	seed

*Chenopodiaceae and the unidentified seed fragment appear lightly carbonized and thus may be recent, rather than archaeological in nature.

Table 6.14. Plant identifications from La Isabela, Dominican Republic (by count). (Values in parentheses are tentatively archaeological; + = wood present in small fragments that were not counted individually or identified.)

IDENTIFICATION:	FS 5416 floor	FS 5375 montero	FS 5304 escudilla	FS 5382 floor	FS 5040 floor	Spanish burial	PLANT TOTAL
WILD EDIBLE:							
Bully-mastic						7*	7*
cf. Bully-mastic				1			1
Goosefoot family			(1)				1
OTHER:							
Unid. hardwood		+	+	+	+		
Unid. seed frag.			(1)				1
MODERN INCIDENTAL:							
cf. Chickweed family	1	2		2			5
cf. Ground Cherry			1				1
Mallow family		1	3	1			5
Mexican poppy			1				1
Purslane			1				1
Sunflower family		1	1				2
cf. Sunflower family			1				1
Unid. spherical seed				1			1
Unid. seed		1					1
TOTAL WOOD TYPES:	0						
SEED TOTAL:	1	5	10	5	0		
ARCHAEO. SEEDS:	0	0	(2)	1	0		

*At least seven individuals, exact total uncertain.

Mastic-bully seed coat fragments then, are widely distributed across time and space in terms of Caribbean archaeobotanical assemblages. The Isabela identifications mark the seventh documented occurrence of mastic-bully and/or Sapotaceae seed coat among the sites described in this thesis (Tables 4.32, 5.21, 6.3).

Summary of the Plant Data from Hispaniola

Between the two sites on Hispaniola there are a total of approximately 50 archaeobotanical identifications (Tables 6.3 and 6.13), including the first direct evidence for the presence of domesticated plants in the Caribbean. Crop species from En Bas Saline deposits include maize, manioc, and probably also sweet potato. A number of potential homegarden plants were identified, including pepper, palm family, and *Oenothera* sp.; also, tentatively identified are soursop, guaba, genip, guava, star-apple (caimito), and bullet-wood. Other potential plant food resources, based on the identifications from En Bas Saline, include unidentified members of the amaranth and goosefoot families (Table 6.3), Panicoid grass, a nightshade, trianthema, and possibly portulaca. In addition to the edible species, at least nineteen other plant types were identified, primarily in the form of wood remains (Table 6.3). These latter identifications represent fuelwood and, to some extent, house-structural members (possible post remains from En Bas Saline); nevertheless, other uses of these plants may have

occurred (for example, tannins from the mangrove genera [Austin and McJunkin 1978; Ayensu 1981]).

Maize remains from En Bas Saline were recovered in association with carbonized remains from other important edible species, including tubers that most likely are manioc and sweet potato (Feature 11). Like maize, neither of these plants has been previously recovered from a prehistoric Caribbean site. Also in association with maize remains at En Bas Saline are carbonized seeds from two presumably important, but not clearly domesticated plants: Capsicum pepper (FS 7035, the central burned structure) and Oenothera sp. (Feature 31, the smaller structure on the northern embankment). How important pepper and Oenothera were to the prehistoric inhabitants of the site is not known, but a relatively dense concentration of Oenothera seeds (244 total) in the early historic Feature 14 located in the chiefly residence arguably demonstrates that it had a significant role in the Taino culture.

Together, the plant remains from En Bas Saline document and underscore the diversity of plant resources used by the site's Taino inhabitants. Domesticated species were fully integrated into the subsistence realm at En Bas Saline by the time the area was first occupied (ca. 1250 A.D.), based on the plant evidence from the site's oldest strata. The mix of crop plants and homegarden species at En Bas Saline is the first archaeobotanical confirmation of the diversity

and complexity of Taino plant production systems described in the ethnohistoric accounts.

CHAPTER 7

SUMMARY AND DISCUSSION

Archaeobotanical data from Caribbean sites currently are few and limited. The shortcoming, however, is less the result of poor preservation, as the previous chapters show, than a reflection of the infancy of paleoethnobotanical research in the region. This study has pulled together in a single treatment all of the currently available macrobotanical data from Caribbean sites. However limited, these data from the various sites and time periods are nevertheless the first direct evidence (that is, in the form of the actual plant remains) profiling the nature of plant use in the region.

Plant exploitation by Caribbean Indians

The physical evidence of the plant remains themselves, combined with the presence of plant-processing artifacts and ethnohistorical observations are beginning to suggest certain patterns of plant use not only for the Caribbean as a whole, but also for subregions and the various culture series. This chapter summarizes the present state of knowledge from an archaeobotanical perspective, based on the data presented in the previous chapters.

Three general themes emerge from viewing these archaeobotanical data in tandem: 1) in broad perspective,

the existance of a uniquely West Indian pattern of plant use is beginning to emerge, one that from the outset combines native and imported species; 2) definite patterns can be defined relating as to the timing and scale of plant introductions and by inference, to the first appearances in the region of gardening, arboriculture, and more intensive forms of plant production (e.g., crop production); finally, 3) the plant data are useful to illuminate the issue of associations and contact with mainland areas of Central and South America through the identification of source areas for particular cultivated and domesticated taxa. Each of these general themes are discussed below.

An emerging profile of plant use in the Caribbean

The replication of species presence from site to site, spanning spatial and temporal boundaries, suggests the existence of an established and long-term pattern of plant use. All together more than seventy types of plants have been recovered from Caribbean archaeological deposits. Seeds belonging to four archaeological taxa--Sapotaceae, palm, evening primrose (Oenothera sp.), and trianthema--are widely distributed, appearing at sites located throughout the island system in deposits representative of nearly the full range of human occupation (Table 7.1). In particular, sapotaceous seed coats--several of which were identified as mastic-bully (Mastichodendron foetidissimum)--appear in association with preceramic-Archaic Age sites, as well as Ceramic Age sites in the Lesser Antilles. The seed coats

Table 7.1. Crop, homegarden, and other plants with food or medicinal value from Caribb sites (presence in macroremains; tentative identifications in parentheses).

	--LESSER ANTILLES-- SOUTHERN	NORTHERN	PUERTO RICO (prehistoric)	PUERTO RICO (historic)	HISPAN-IOLA	BAHAMAS/ SO. FLORIDA
CROP SPECIES:						
Maize, flour type *				(BB)	EBS	
Maize, popcorn *					EBS	
Manioc *					EBS	
?cassava bread		(TB)			EBS	
cf. Sweet potato *					EBS	
Unid. starchy tissue		(HE)			EBS	
HOMEGARDEN TREES:						
Avocado (wild) *			MC			
Bully-tree/jacana			M, CC, (EF)			
Calabash tree			(M), (EB)			
Genip/quenepa					(EBS)	
Genipa/jagua					(EBS)	
Guava			(M)		(EBS)	
Inga/guaba			M		EBS	
Palm family	HW, P	(KB)	EB	BB	EBS	SF
Panama tree *			(M)			
Papaya *			EP	BB		SF
Sapodilla		KB				
Soursop (*)			(EB)	BB	(EBS)	
Star-apple/caimito					(EBS)	
Yellow sapote *			MC			
HOMEGARDEN HERBS:						
Pepper/pimiento (*)				BB	EBS	SF
Primrose		HS	EL, EP		EBS	
Tomato *				BB		
OTHER FOOD/MEDICINAL:						
Bullet-wood/ausubo					(EBS)	
Clusia/cupey						

Table 7.1--continued.

OTHER FOOD/ MEDICINAL:	--LESSER ANTILLES-- SOUTHERN	NORTHERN	PUERTO RICO (prehistoric)	PUERTO RICO (historic)	HISPAN-IOLA	BAHAMAS/ SO. FLORIDA
Cockspur	P	TW, IC, GR, TB				SF
cf. Coconut				BB		
Fig, wild		KB	(EF)			SF
Fish poison		GR, (HE)				SF
Goosefoot family			EB, EF, EP		EBS	
Ground cherry				BB		
Lignum-vitae/guayacan	W	HiS, IC,	EB			3-D
Manchioneel	HW	(HiS)				
Mangrove species	W, MM	KB			EBS	3-D, SF
Mastic-bully	P	KB, (TW), (HS)		(BB)	IS	3-D, LC, SF
Panicoid grass			EB	BB	EBS	SF
cf.Prickly pear (tuna)				BB		SF
Trianthema		KB	M		EBS	SF
Wild raspberry			EF	BB		
OTHER ?USEFUL:						
Stargrass			EF, EP		EBS	

* Derives from other areas of the American tropics; Old World taxa from historic Barrio Ballaja are excluded here. (*) = possibly originating elsewhere than West Indies.

Site notations:
Southern Lesser Antilles (and Bonaire) sites: W = Wanapa, P = Pearls, HW = Heywoods, MM = Macabou, Martinique. Northern Lesser Antilles sites: JB = Jolly Beach, TW = Twenty Hill, HS = Hichmans' Shell, HiS = Hichmans' Site, IC = Indian Castle, GR = Golden Rock, HE = Hope Estate, TB = Trunk Bay, KB = Krum Bay
Puerto Rico sites: MC = Maria de la Cruz Cave, M = Maisabel, CC = Calle del Cristo, EB = El Bronce, EF = El Fresal, EP = El Parking, BB = Barrio Ballaja
Hispaniola sites: EBS = En Bas Saline, IS = Isabela
Bahamas/Florida sites: 3-D = Three Dog Site, LC = Luden's Cave, SF = South Florida sites combined (see Newsom 1991, Scarry and Newsom 1992, Scarry et al. 1989).

also were recovered from prehistoric and Contact period deposits at En Bas Saline, Haiti, from a Spanish burial at Isabela, Dominican Republic, and from eighteenth-century domestic deposits at Barrio Ballaja, San Juan, Puerto Rico. In still broader perspective, Mastichodendron seed fragments also have been identified from site deposits in the Bahamas (Luden's Cave and the Three Dog Site [Newsom laboratory data from faunal samples analyzed by Elizabeth Wing] and in South Florida [Scarry et al. 1989; Scarry and Newsom 1992]). Thus mastic-bully fruit currently is the most extensively documented plant-food resource in the Caribbean, spanning cultural, temporal, and geographic boundaries.

Palm family (Palmae) hard seed coat fragments are nearly as ubiquitous among Caribbean sites as are sapotaceous (mastic-bully) seed coats. Both the mastic-bully and palm fruits were probably gathered as fresh-fruit resources that were abundantly and reliably available to the various human groups of the islands.

Oenothera and trianthema seeds are temporally and spatially distributed in much the same way as Sapotaceae and Palmae seed coats. That is, seeds of the two plants have been recovered from sites in the Lesser Antilles, on Puerto Rico, and on Hispaniola (Table 7.1). Specifically, Oenothera and trianthema are documented from Archaic Age (Hichmans' Shell Heap, Nevis; Krum Bay, St. Thomas [Table 4.32) through Ceramic Age (Maisabel, El Fresal, and El Parking sites, Puerto Rico; En Bas Saline, Haiti), and in

post-contact deposits (En Bas Saline) (Table 7.1). Both plants have potential value as food and for medicinal purposes. Oenothera possibly was introduced into the Caribbean islands by Archaic Age people, based on its earliest known presence at Hichmens' Shell Heap, Nevis (Chapter 4); the basis for Oenothera's present restriction in geographic range is not clear and requires more research. The best evidence thus far for deliberate use of Oenothera, rather than presence (in site deposits) by natural dispersal of nearby weed seeds, is in the concentration of Oenothera seeds (244 total) from Feature 14 at En Bas Saline. Potentially important is the fact that Feature 14 is associated with the chiefly residence. Additional supportive evidence for Oenothera use is the co-occurrence of Oenothera seeds with maize and/or manioc tubers--plant remains that unquestionably represent food resources--in four out of seven occurrences of Oenothera at the site (Table 6.4). However tantalizing is the evidence thus far presented of range extensions and association with features and known food plants, it is abundantly clear that more data are needed to better understand the presence of Oenothera in Caribbean archaeological contexts, and to clarify the basis for its previously broader geographic distribution.

Other wild plant foods from Caribbean site deposits seem to have had more restricted distributions and use, and thus far are recorded only for certain time periods or island groups. For example, cockspur seeds were identified

from five Lesser Antilles sites [Tables 4.32 and 7.1], but are not part of the inventory of seed identifications from the Greater Antilles. Conversely, Chenopodiaceae and a fairly diverse array of other weedy taxa with edible greens and seeds, and fruit trees appear more frequently in Greater Antilles sites. Greater Antilles deposits also produced the first macroremains of domesticated species.

Similar patterning in the seed distributions seems to be suggested by wood remains from Caribbean sites. The mangrove species appear in archaeological deposits throughout the island chain. Mangroves are particularly conspicuous in samples from En Bas Saline, Haiti; mangrove woods also appear in association with Lesser Antilles sites (Table 7.2).

Other wood types seemingly are indicative of wood use in either the Greater or the Lesser Antilles. Lignum-vitae and satinwood are dominant among the wood remains from Lesser Antilles sites (Table 7.2), but the two wood types are inconspicuous or absent in charcoal assemblages from the Greater Antilles, even though members of both genera occur in the separate island group. Conversely, sapotaceous woods are most ubiquitous among the Greater Antilles sites, but in terms of wood remains appear infrequently in the Lesser Antilles deposits.

As intriguing as the apparently patterned distributions of wood and seed types seem to be, much more data and research are needed to clarify the plant distributions and

Table 7.2. Wood remains from Caribbean archaeological sites (presence). (Tentative identifications shown in parentheses.)

	--LESSER ANTILLES-- SOUTHERN	NORTHERN	PUERTO RICO (prehistoric)	HISPANIOLA (En Bas Saline)
MANGROVE GENERA:				
Avicennia (Black mangrove)	MM			EBS
Conocarpus (Buttonwood)	W	KB, BA	(EB)	EBS
Laguncularia (White mangrove)		KB		
Rhizophora (Red mangrove)				EBS
OTHER WOODS:				
Acacia (acacia/aroma)			EP	
Andira inermis (moca)			EB	
Annona (pond apple/soursop)			EB	
Bignoniaceae, cf. Cedar	W	KB	M, EB	
cf. Bignoniaceae		TB		
cf. Bignoniac. (Bignonia)	HW			
Bombacaceae/Malvaceae	HW			
Boraginaceae (borage family)			EB	
Bourreria (Strong bark)	W	(HiS), HE		
Bumelia (Boxwood)	W			EBS
cf. Caesalpinia (Gray nicker)		HE		
Capparis (Caper tree)	W	KB	EB	
cf. Capparis sp.	W	KB		
Casearia (Wild cherry)	W			
Cassine (marble-tree)			M	
cf. Ceiba (Kapok tree)		HE		
cf. Celastraceae (Spindle tree)		KB, GR		
Clusia (Cupey)		KB		
Coccoloba (Sea Grape)			EB	
cf. Colubrina (Snake-bark)				EBS
Croton (Pepper bush)		KB, (GR)	EB	
cf. Dipholis (Bustic)		TW, GR		
Drypetes (Guiana plum)	HW			
cf. Erithalis (Black torch)		GR		(EBS)
Erythroxylon (False cocaine)			EB	

Table 7.2--continued.

	--LESSER SOUTHERN	ANTILLES-- NORTHERN	PUERTO RICO (prehistoric)	HISPANIOLA (En Bas Saline)
cf. Eugenia (Stopper/anguila)				EBS
Exostema (West Ind. Quinine)			EB	
Fabaceae (cf. Acacia)		KB		
Fabaceae (cf. Leucaena)		KB		
cf. Fabaceae (tree legume)			EB	
Ficus (wild fig)		KB	(M), (EF)	
Flacourtiaceae (cf. Roseta)	W			
Genipa/Gossyp. (jagua/boxwood)				EBS
Guaiacum (Lignum-vitae)	W	HiS, IC,	EB	
cf. Guazuma (West Indian elm)				EBS
Hippomane (Manchioneel)	HW			
Hura crepitans (Monkey pistol)				EBS
Inga (Guaba)			M	EBS
cf. Lauraceae (Laurel family)				EBS
Licaria-type (Sweetwood)				EBS
cf. Meliaceae (Mahogany)	HW			
cf. Melicoccus (genip/quenepa)				EBS
Metopium/Ocotea (poison/spicewd)				EBS
Montezuma (maga)			M	
Myrtaceae (cf. Stopper)	HW			
Myrtaceae (Guava or stopper)				EBS
Palm family	HW		EB	EBS
Pinus sp. (Caribbean pine)				EBS
Piper (Higuillo)		KB		
Piscidia (Fish poison)		GR, (HE)		
Pouteria (Bully-tree/jacana)			M, CC, (EF)	
cf. Psidium (guava/guayaba)			M	
Rubiaceae (Madder fam.)		GR		
Sapotaceae (Sapote family)			(EF), EP	
Sapotaceae (star-apple type)				EBS
Sapotaceae (bullet-wood type)				EBS
cf. Sterculia (Panama-tree)*			M	

Table 7.2--continued.

	--LESSER ANTILLES-- SOUTHERN	NORTHERN	PUERTO RICO (prehistoric)	HISPANIOLA (En Bas Saline)
cf. Suriana (Bay cedar)		GR		
Tecoma stans (Roble amarillo)			EB	
Zanthoxylum (Satinwood)	MM	GR, HE, BA		
Zanthoxylum (Wild lime)		GR		

*Derives from other areas of the American tropics.

Site notations:
Southern Lesser Antilles sites: W = Wanapa, P = Pearls, HW = Heywoods, MM = Macabou, Martinique. Northern Lesser Antilles sites: JB = Jolly Beach, TW = Twenty Hill, HS = Hichmans' Shell, HiS = Hichmans' Site, IC = Indian Castle, GR = Golden Rock, HE = Hope Estate, TB = Trunk Bay, BA = Beach Access Site, KB = Krum Bay
Puerto Rico site: M = Maisabel, CC = Calle Cristo, EB = El Bronce, EF = El Fresal, EP = El Parking Site

interpret the presence of the various taxa in Caribbean sites. The presently documented situation in which greater diversity of homegarden species, including fruit trees and herbaceous taxa, seems to correlate with Greater Antilles sites needs clarification. The apparent lesser emphasis on homegardening and arboriculture in conjunction with Lesser Antilles prehistoric occupations may be a function of preservation and sampling biases, rather than the actual situation. In many cases additional careful excavation is needed to discern whether weed seeds in the samples, e.g. Chenopodiaceae or stargrass, are from plants that were used for some purpose, or whether their occurrence in the deposits is fully incidental to the human occupations, as was discussed above in previous chapters.

The timing and scale of plant introductions

The presence of a number of well-known homegarden plants in the Caribbean site assemblages is intriguing. Archaeobotanical data for the Ortoiroid and the Casimiroid series are scant, but nevertheless present some interesting and heretofore unsuspected possibilities. In combination, data from the Archaic Age deposits seem to indicate that gardening and/or limited aboriculture was initiated with the pre-Saladoid occupations. This assumption is based on the presence of important fruit and medicinal species that very likely were introduced from mainland areas. Possible plant introductions dating to the Caribbean Archaic include a wild form of avocado (Persea americana [Mexico]) and yellow

sapote (Pouteria campechiana [Central America]) from the Maria de La Cruz cave excavations (Rouse and Alegria 1990), sapodilla sp. (Manilkara [zapota]; Central America and Caribbean coast) from Krum Bay (Pearsall 1983; see Chapter 4), and Oenothera sp. at Hichmans' Shell Heap, Nevis.

The inventory of homegarden species and, by inference, evidence for aboriculture and gardening, increases with the Ceramic Age plant identifications (Table 7.1). An important point to consider is that if Archaic cultures in the islands were indeed gardening and exercising some control over plants, then the earliest interaction between Ortoiroid/Casimiroid and Saladoid people needs to be reevaluated. In other words, archaeologists have maintained that a striking contrast existed between the subsistence economies of preceramic and of ceramic-producing cultures in the Caribbean. Archaic groups are generally thought to have been rather non-specialized fisher-foragers (Krieger 1929:488-489; Rouse 1992:69-70; Sanoja 1989:532-533), while the Cedrosan Saladoid demonstrably entered the insular environment as root-crop horticulturists. If Archaic Age people were already gardening and tending plants when Saladoid immigrants appeared, then the Saladoid did not enter the archipelago with such a vastly, if at all, different approach to subsistence, as was previously thought. Archaic groups may have facilitated Saladoid familiarity with island resources, for example, by their

knowledge of productive soil types, hastening the adaptation of Saladoid people to the insular environment.

The earliest appearances and the locations of domesticated plants in the Caribbean islands needs to be established. The current data demonstrate little more than that domesticated species were present shortly prior to European contact (based on the discovery of maize and tuber remains at En Bas Saline, Haiti). Currently, approximately A.D. 1250 is the earliest date associated with domesticated plant remains at En Bas Saline.

Even though actual remains from domesticated plants have been recovered only from a single site and in relatively late deposits, artifactual evidence suggests crops possibly were more widely distributed and were introduced much earlier. The presence at numerous sites throughout the region of griddle fragments and grater-board teeth--both of which were very likely associated with cassava production--suggests that manioc, at least, was introduced as early as the middle of the first millennium B.C. with the Cedrosan Saladoid migration (Rouse 1992). Other plant processing tools, milling equipment in particular, appear as early as the Caribbean Archaic (Harris 1973, 1976; Moore 1982; Rouse 1982, 1992; Veloz Maggiolo and Ortega 1976), but they do not necessarily imply the presence of domesticated plants.

Currently pollen analytical data are too few and ambiguous to shed additional light on the timing and spread

of cultigens in the Caribbean islands. Five palynological studies of prehistoric sites on Hispaniola and Puerto Rico have been completed (Fortuna 1978, n.d.; García Arévalo and Tavares 1978; Higuera-Gundy 1991; Nadal et al. 1991; Rouse and Alegria 1990); even though pollens of cultivated and otherwise useful plants were documented in some of the profiles, the temporal placement for each of the identifications is tenuous, as discussed in Chapter 1.

Historic records mention at least seven types of root crop that were regularly cultivated by the Taino at the time Europeans arrived. Manioc (*Manihot esculenta*) and sweet potato (*Ipomoea batata*) were the most important plant staples in the Caribbean islands, with manioc ("yuca") functioning as the primary crop. The Taino referred to sugary sweet potatoes as "batata"; less sweet forms were called "aje" (or "age") (Sauer 1966:54). Las Casas's description of manioc planting and use (*Apologetica*, Chapter 10 [in Sauer 1966:53]) implies that bitter manioc cultivars were grown, based on the information that the first crop of tubers was available one to one and a half years after planting (typically the case with bitter forms of manioc), and that the tubers were prepared by grating, juicing, and baking the pulp (to eliminate toxins). The tubers from sweet or non-bitter manioc cultivars can be harvested for consumption within approximately six months of planting. These are thought by Sauer (1966:54) also to have been produced by the Taino.

Additional Taino root crops, according to Oviedo (1959), included "yautía" (Xanthosoma jacquinii), "araru" or arrowroot (Maranta arundinacea), "ileren" (Calathea allouia), "yampee" (Dioscorea trifida) (note that Dioscorea may be an early introduction from Africa, rather than a native root crop), and an edible-rooted form of Canna sp. Veloz Maggiolo (personal communication) has suggested that Zamia sp. also was a key element in the Taino root-cropping system. Any or all of these tuber crops, in addition to manioc, could have been associated with the food-processing equipment that is recovered from the Caribbean sites. Thus, until and in lieu of the actual plant remains, it is difficult to establish how and when these additional tuber crops were integrated into indigenous systems of food production.

Thus, while the combined data confirm early historic descriptions of gardening and crop production in the Caribbean, our understanding of the evolution and development of plant-food production is still incomplete. The evidence suggests that gardening and extensive forms of plant-food production were long established, beginning in the Archaic Age. Elaboration and diversification of the plant-subsistence realm, including in some areas the addition of maize agriculture, seem to be developments that occurred with the later-ceramic Ostionoid occupations on Puerto Rico and Hispaniola. The transition to more intensive forms of crop/plant production may have progressed

relatively slowly, beginning with the combination-tuber cropping by Saladoid (? and Archaic) people, and developing locally into agricultural systems that incorporated maize, and in some cases also, more labor-intensive forms of agriculture including bench terraces in Puerto Rico (Ortiz Aguilu et al. 1991) and irrigated ditch networks on Hispaniola (Krieger 1929:488; Las Casas 1909, ch.5:15, ch. 60:154). Why maize may have been less important in the West Indies than on the nearby mainland (Las Casas 1971; Sauer 1966; Sturtevant 1961) is still unclear, although parallels in both South and North America offer important hypotheses to account for the situation.

Maize may have entered the West Indies at a relatively late date. The plant does not appear to have become a major staple in northern Amazonia until well after the first Cedrosan Saladoid horticulturists began their migration into the Caribbean islands (Pearsall 1990; Roosevelt 1980; Rouse 1986; Sanoja and Vargas 1983; van der Merwe et al. 1981; Zucchi et al. 1984). The insular environment may have been even less conducive five centuries ago to the production of early varieties of maize (Litzenberger n.d.); corn is not a staple crop among subsistence farmers in the Greater Antilles today, nor is it a significant part of the Caribbean diet.

Given these factors, it is possible that maize simply was overshadowed by the primary system of root cropping and arboriculture that seems to have become established quite

early in the islands (Davis 1988; Rouse 1986, 1992). Such a situation would parallel Pearsall's (1990) partial explanation for the delayed spread of maize into northeastern South America, and Smith (1990) for its delayed and restricted use in eastern North America (wherein the plant plays a minor role due to the preeminence of established staples and modes of production). Furthermore, the predominant forms in which maize seems to have been consumed in the islands, that is, picked green and eaten raw, "almost like milk" (Oviedo 1959), or roasted (Ortega and Guerrero 1981; Sauer 1966; Oviedo 1959, Sturtevant 1961), are consistent with what Pearsall (1990) describes as low intensity use, more as a vegetable or curiosity (as in popcorn) than as a storable staple carbohydrate source (dried kernels, ground meal and flour).

As paleoethnobotanical research expands in the Caribbean, it may also be possible to show that the low intensity use of maize in the region, as Keegan has suggested (personal communication, May 1993), is a reflection of the fact that it is an expensive source of protein. Keegan hypothesizes that maize was not important in the West Indies because alternative sources (i.e. marine resources) were available at a lower economic cost.

The Tainan society truncated by the arrival of Europeans in 1492 was a socially stratified, horticultural economy based on root crop production. The occurrence of prehistoric maize in a restricted array of contexts at En

Bas Saline (i.e. principally the chief's domicile)--a village that is demonstrably the focal point of a Taino chiefdom--provides a basis for hypothesizing that restricted elite access to maize may have operated in the prehistoric Caribbean, even after the emergence of complex sociopolitical formations.

Restricted access to maize by privileged (i.e. chiefly) social segments has been suggested as a factor in the introduction of maize into the southeastern United States (B.D. Smith 1990). Although maize was present in the southeastern region between about A.D. 200 and A.D. 800 (a time of multiple seed crop-based food production [see, for example, B.D. Smith 1989, 1990]), it did not become the primary crop staple until sometime after A.D. 800, and may have served as a controlled ceremonial crop during the earlier period (B.D. Smith 1989, 1990).

Plant origins and contacts with mainland areas

The presence in Caribbean archaeological deposits of economic species that are known to have been and still are important elsewhere in the Neotropics is noteworthy. This indicates a broader pattern of plant use and a continuity with traditions from mainland tropical America. Plants of this nature include manioc, maize, sweet potato, pepper/pimiento, tomato, avocado, bully-tree, calabash tree, guava, guaba, genip, jagua, palm fruit, Panama tree, papaya, panicoid grass, sapodilla, soursop, star-apple (caimito), and yellow sapote (Table 7.1). In some cases the actual

species represented in the Caribbean sites may be native, for example, Inga sp. (guaba) or Pouteria sp. wood from Maisabel. Nevertheless, the use of closely related species in mainland areas suggests a tradition of use that was extended in the island environment to similar resources for which general familiarity was gained on the mainland. Others of the plant identifications, for example, avocado, clearly represent imported plants, deriving from other areas of the American tropics (Table 7.1). Sapodilla (Krum Bay, tentative identification), avocado, and yellow sapote (the latter two from the Maria de la Cruz cave) all are native to Mexico/Central America. They possibly were transported to the Greater Antilles and Virgin Islands by Casimiroid people, who are believed to have migrated from Yucatan (Krieger 1929:485; Rouse 1991, 1992:71). Other plant introductions probably came from the south in conjunction with Ortoiroid and later Saladoid migrations (Rouse 1991, 1992). Use by Saladoid people and their decendents of the same or similar plant assemblages as characterized mainland food production could be construed as supportive of the hypotheses by Roe (1989) and others (Davis 1988; Goodwin 1980; Jones 1985; Peterson and Watters 1991; Rouse 1989; and see review by Keegan 1985, n.d.) that portray the Saladoid in an attempt to replicate their mainland existence in the insular setting.

Panicoid grasses and other small grains, e.g. trianthema and goosefoot (Chenopodiaceae) (Table 7.1),

appear in the Caribbean archaeobotanical assemblages in addition to the more conspicuous seeds of fruit trees and crop residues mentioned above. Panicoid grasses, e.g. millets (Setaria spp.) have a long association with human groups and a checkered history of manipulation and domestication by various peoples (Harlan 1975, 1989; Prasada Rao et al. 1987). C.E. Smith (1967) and Callen (1965, 1967a) documented a period of panicoid (Setaria sp.) exploitation in pre-Columbian Mexico that began with the consumption of gathered seeds from wild populations and in Tamaulipas culminated in deliberate manipulation of plants with selection for large seeds. All of this occurred prior to reliance in Mexico on maize as a plant staple. A similar situation occurred in the southeastern United States where starchy seeds from annuals--particularly, maygrass, knotweed, little barley and goosefoot varieties--were manipulated and cultivated long before the transition to maize-dominated field agriculture (Fritz 1984, 1986, 1987; B.D. Smith 1986, 1989).

Callen's (1967a) Setaria seeds from the Mexican sites are associated with grinding stones. It is worth considering that small grinding stones recovered from En Bas Saline and from other Caribbean sites may have been used to mill panicoid grass seeds, possibly well in advance of the entry of maize and root-crop horticulture into the region. Callen (1967a, b) hypothesized that the grinding/milling technology developed in Mexico to process Setaria and other

grass seeds into an edible form became the template upon which maize was later substituted. Southeastern archaeologists extend this hypothesis further. As Smith (1986:51) states, exploitation of starchy seed bearing plants "provided a preadaptive context, and partial explanation of, the shift to maize-dominated agricultural systems . . . [in the Southeast]." It is interesting to consider in this regard the numerous grinding stones associated with preceramic Caribbean sites (Moore 1982; Rouse 1982; Harris 1973; Veloz-Maggiolo 1976). With more data it may be possible to show that a pre-maize seed grinding/milling system similar to that which occurred in the Tehuacan Valley was early in place in the Caribbean. There is no reason to assume that this technology had to wait for the migration of Saladoid people into the Caribbean, since Lithic and Archaic Age people were fully capable of such a level of technology and plant production. To this point it should be noted that wild grasses can be quite productive. Harlan (1989), for example, has found that yields from wild grain can equal and sometimes better those produced by subsistence farming and may also be more nutritious. Moreover, the archaeobotanical evidence from Archaic Age sites, meager as it is, suggests from the presence of avocado, yellow sapote, and perhaps also, sapodilla and <u>Oenothera</u>, that tending fruit trees and other valuable plants was a pattern already in existence during the earlier part of human occupation in the Caribbean

islands. In other words, the Casimiroid and Ortoiroid cultures, like their counterpart Archaic age groups on the mainland (Linares and Ranere 1971; Pickersgill 1989; Piperno 1989; Ranere 1976; Sanoja 1989), were probably not simple fisher-foragers, as I have suggested above, but instead were quite familiar with plants, plant life histories, and the effects of direct or passive manipulation of local plant populations (and see Sanoja 1989; Veloz-Maggiolo 1976).

Interestingly, bone chemistry analyses of prehistoric human bone from Caribbean sites have produced maize-like carbon isotope signatures (Keegan's values [1987, 1993] are from three Lucayan Taino skeletons that post-date A.D. 1200; Van Klinken's results [1991] derive from 40 preceramic and ceramic-aged individuals from Aruba, Curacao and Bonaire). However, to reiterate, there currently is no conclusive evidence for the presence of maize in Caribbean sites prior to approximately A.D. 1300. In this regard it is noteworthy that Panicoid grasses, such as have appeared in the Caribbean archaeobotanical assemblages, like maize are C4 plants (Bender 1968; 1971; Chazdon 1989; Downton 1971; Smith and Epstein 1971). Thus, it is possible that the bone chemistry data indicative of reliance on C-4-pathway plants may result from an emphasis on Panicoids and other (wild) grasses rather than maize (Van Klinken [1991] posits that the maize-like ratios may reflect extensive consumption of shellfish and sea turtles). This alternative to maize consumption is also suggested by an isotopically and

archaeobotanically reconstructed diet for Tehuacan, Mexico (Callen 1967a, b; Farnsworth et al. 1985); panicoids and other locally available C-4 herbs should be considered in continuing research on dietary reconstructions for Caribbean areas.

Concluding remarks

The growing body of evidence that includes the macrobotanical remains discussed herein, dessicated Zamia sp. leaves in cave deposits (Veloz and Vega 1982), recent pollen studies (Fortuna 1978 and n.d.; Garcia Arevalo and Tavares 1978; Higuera-Gundy 1991; Nadal 1991), and bone-chemistry data (Keegan 1987, 1993; Van Klinken 1991), is increasingly refining our understanding of the botanical aspect of food production in the Caribbean. Taino people and their Saladoid predecessers relied on manioc and other root crops, and seem to have placed relatively little emphasis on maize. This is corroborated at En Bas Saline by the food preparation-related material assemblage, which contains abundant items associated with manioc/tuber processing; clay griddles, coral graters, and small stone "teeth" from wooden graters are common in all periods. The concomitant absence of recognizable grinding stones or mortars at En Bas Saline indicates that maize and grains, if used commonly, were not grown to full maturity, dried and ground in any known contemporary fashion (an essential step in rendering maize a storable food staple). Conversely, the presence of weedy, edible taxa and native, as well as

imported fruit-bearing trees is fairly consistent and widespread among the archaeobotanical assemblages from the West Indies. The evidence seems to indicate that wild grains and fruit trees were established food resources prior to the entry of ceramic-manufacturing cultures into the Caribbean islands. Some of these plant foods (Table 7.1) are high in carbohydrates, oils, proteins, and/or minerals, and would have been essential supplements to a diet rich in seafood and starchy staples (DeFrance 1989; Reitz 1993; Sturtevant 1961, 1969; Wing and Scudder 1980). The regular procurement of supplemental plant foods might have occurred opportunistically, perhaps embedded in other activities, e.g., shellfish or fuelwood collection, and, in later times, revolving around crop production.

Having documented domesticated plants from prehistoric contexts at En Bas Saline is especially noteworthy because the pace of change and transfer of plant and animal foods around the New World occurred rapidly once Europeans entered the region. Thus historic documents may be unreliable indicators of the late prehistoric situation relative to whether or not particular resources like maize were present and the degree of local emphasis placed on different food items.

Many questions remain as to the nature of plant food production in the Caribbean, both locally and on a regional scale. Plant introductions, agricultural intensifications, and cultural evolution are interrelated phenomena that are

far from defined. This study and work by Pearsall have begun to outline the timing and tradjectory of the plant aspect of Caribbean subsistence. To develop further our understanding of plant use in the West Indies requires more thorough coverage of individual sites and time periods, including greater volumes and numbers of samples, and an emphasis on site-specific contexts, e.g. features and hearths, rather than, for example, general level deposit or column samples through shell middens.

APPENDIX A

SYSTEMATIC LIST OF PLANT SPECIES IDENTIFIED IN CARIBBEAN ARCHAEOLOGICAL SITES

GYMNOSPERMS
Pinaceae

- *Picea* sp. (timber import)
- *Pinus* sp., section Diploxylon

ANGIOSPERMS
Aizoaceae

- *Mollugo* sp.*
- *Trianthema portulacastrum*

Amaranthaceae

- *Amaranthus* sp.*

Anacardiaceae

- cf. *Comocladia* sp.
- cf. *Metopium* sp.

Annonaceae

- *Annona* (*muricata*)

Arecaceae = Palmae

- cf. *Cocos nucifera*
- *Sabal* sp.

Asteraceae = Compositae

- *Bidens* sp.*

Avicenniaceae

- *Avicennia germinans*

Bignoniaceae

- cf. *Bignonia* sp.
- *Crescentia* sp.
- *Tabebuia* sp.

cf. Bombacaceae

- cf. *Ceiba* sp.

cf. Cactaceae

- cf. *Opuntia* sp.

Appendix A--continued.

Capparidaceae

Capparis sp.

Caricaceae

Carica papaya

Caryophyllaceae

cf. *Cerastium* sp.*

cf. Celastraceae

Cassine xylocarpa

Chenopodiaceae

cf. *Atriplex* sp.*
cf. *Suaeda* sp.

Cleomaceae

cf. *Cleome* sp.

Combretaceae

Conocarpus erectus

Cucurbitaceae

cf. *Momordica charantia*

Cyperaceae*

Ehretiaceae

Bourreria (*succulenta*)

Euphorbiaceae

cf. *Croton* sp.
Drypetes sp.
*Euphorbia nutans**
Euphorbia sp.*
Hippomane mancinella
Hura crepitans
cf. *Manihot esculenta*
cf. *Ricinus communis** (Old World)

Fabaceae

Acacia (*farnesiana*)
cf. *Caesalpinia* sp.
cf. *Cassia* sp.*
Desmodium sp.*
cf. *Inga* sp.
Mimosoideae*
Piscidia carthagenensis = *P. piscipula*

Fagaceae

Quercus sp. (timber import)

Appendix A--continued.

Flacourtiaceae

Casearia (*tremula*)
cf. *Gossypiospermum* sp.
cf. *Xylosma* (*arnoldii*)

Hypoxidaceae

Hypoxis sp.

Lauraceae

cf. *Licaria* sp.
cf. *Ocotea* sp.
Persea americana

Malvaceae

cf. *Hibiscus* sp.
cf. *Sida* sp.*
Montezuma grandiflora
cf. *Urena lobata**

cf. Meliaceae

Moraceae

cf. *Ficus* sp.
cf. *Ficus carica* (Old World)

Myrtaceae

cf. *Eugenia* sp.
cf. *Psidium guajava*

Oleaceae

cf. *Fraxinus* sp. (timber import)

Onagraceae

Oenothera sp.

Oxalidaceae

Oxalis sp.*

Papaveraceae

Argemone mexicana

Passifloraceae

Passiflora sp.

Poaceae = Gramineae

cf. *Bouteloua* sp.*
cf. *Cynodon* sp.*
*Dactyloctenium aegyptium** (Old World)
*Eleusine indica**
Paniceae
cf. *Paspalum* sp.*

Appendix A--continued.

	Setaria sp.*
	Zea mays
Portulacaceae	
	Portulaca sp.*
Rhamnaceae	
	cf. *Colubrina* sp.
Rhizophoraceae	
	Rhizophora mangle
Rosaceae	
	Rubus sp.
Rubiaceae	
	cf. *Erithalis fruticosa*
	cf. *Genipa americana*
Rutaceae	
	Citrus sp. (Old World)
	Zanthoxylum sp.
Sapindaceae	
	cf. *Melicoccus bijugatus*
Sapotaceae	
	Bumelia (*obovata*)
	cf. *Chrysophyllum* sp.
	Dipholis sp.
	Manilkara sp.
	Mastichodendron foetidissimum
	Pouteria sp. = *Lucuma* sp.
	Pouteria campechiana = *Lucuma salicifolia*
Solanaceae	
	Capsicum sp.
	Lycopersicon lycopercicum
	Physalis sp.
	Solanum sp.
Sterculiaceae	
	cf. *Guazuma ulmifolia*
	Sterculia apetala
Surianaceae	
	cf. *Suriana maritima*
Ulmaceae	
	Celtis iguanaea

Appendix A--continued.

Vitaceae

Vitis (*vinifera*) (Old World)

Zygophyllaceae

Guaiacum sp.

* indicates modern (not definitively archaeological)

APPENDIX B

PLANT IDENTIFICATIONS FROM EN BAS SALINE: SEEDS AND OTHER NONWOOD REMAINS

Appendix B. Plant identifications from En Bas Saline: Seeds and other nonwood remains (by count; ++ = abundant, but not individually counted).

IDENTIFICATION:	GARDEN B: Feat.24 Bur.01 FS6989	----Feature 31---- Lv.1 FS7190	Lv.2 FS7198	Lv.3 FS7197	Lv.3 FS7213	Lv.4 FS7211	Lv.4 FS7332	Fea.31A Lv.1 FS7199	Fea.31B Lv.1 FS7202
CULTIVATED:									
cf. Guava				1					
Maize/Indian corn	1		2						
cf. Manioc/cassava tuber		(1)	(1)+		(2)				
Palm, seed coat									
Palm, fibrous tissue									
Pepper/pimiento									
Primrose		1	(1)						
cf. Soursop									
cf. Sapotaceae seed coat			3						
OTHER:									
Amaranthac./Chenopodiac.	1								
Goosefoot family									
cf. Inga/guaba			2	2					
Nightshade family									
Panicoid grass		1		4					
Purslane	1	14	2		3		7	3	
Trianthema	1	3	1		(1)		1		
cf. Grass family									
Legume, wild									
Mallow family									
cf. Myrtaceae					1				
cf. Palmae seed/bud									
Yellow stargrass									
Unid. seed-type 1									
Unid. seed-type 2									
Unid. seed-type 3				5					
Unid. seed-type 4									
Unid. seed-type 5			1		1				
Unid. seed/fruit frag.		1		1	1				

Appendix B--continued.

IDENTIFICATION:	GARDEN B: (continued) Feat.24 Bur.01 FS6989	----------------Feature 31 Lv.1 FS7190	Lv.2 FS7198	Lv.3 FS7197	Lv.3 FS7213	Lv.4 FS7211	Lv.4 FS7332 ----------------	Fea.31A Lv.1 FS7199	Fea.31B Lv.1 FS7202
Unid. s.coat/periderm		2		2					
Unid. soft tissue	3	17	84		31	2	28	30	
MODERN SEEDS:									
Amaranth									
cf. Bur									
Carpet weed		1	1			1		1	
Crowfoot grass									
cf. Cyperus sp.				1					
Euphorbia nutans				3					2
Euphorb, cf. Ricinus									
cf. Goosefoot family									
Grass family				1					
cf. Ground cherry									
Guava									
Legume family					2				
Mallow family				8					
Mexican poppy									
Panicoid grass			1	2			1		
Portulacaceae				20					
Purslane						2			4
Sunflower family				1					
Unid. spherical seed						1			
Unid. triangular seed				15		5			
Unid. seed, crenate									
Unid. lobed fruit				1					
Unid. seed				8		1			
SEED TOTAL:	7	22	14	75	9	10	9	4	6
ARCHAEO. SEED TOTAL:	5	20	12	15	7	0	8	3	0

Appendix B--continued.

IDENTIFICATION:	Garden B continued ------Feature 33---- Lv.1 FS7192	Lv.3 FS7215	Lv.4 FS7214	Feat.33A Lv.1 FS7216	Feat.35 Lv.2 FS7422	Post-mold-1 FS7527	Post-mold-3 FS7443	Post-mold-6 FS7530	Area 1 lv.1 FS7065
CULTIVATED:									
cf. Guava									
Maize/Indian corn			(1)	2(2)					
cf. Manioc/cassava	(2)	(1)	2						
Palm, seed coat									
Palm, fibrous tissue									
Pepper/pimiento									
Primrose									
cf. Soursop		1							
cf. Sapotaceae seed coat									
OTHER:									
Amaranthac./Chenopodiac.									1
Goosefoot family			1						
cf. Inga/guaba	1	1		2					
Nightshade family									
Panicoid grass		7	7	1					
Purslane		1	6						
Trianthema					2				
cf. Grass family									
Legume, wild									
Mallow family									
cf. Myrtaceae									
cf. Palmae seed/bud				3					
Yellow stargrass									
Unid. seed-type 1									
Unid. seed-type 2		1							
Unid. seed-type 3									
Unid. seed-type 4									
Unid. seed-type 5									
Unid. seed/fruit frag.	3	7	1	8					

Appendix B--continued.

IDENTIFICATION:	Garden B (continued) ------Feature 33-----			Feat.33A	Feat.35	Post-	Post-	Post-	Area 1
	Lv.1	Lv.3	Lv.4	Lv.1	Lv.2	mold-1	mold-3	mold-6	lv.1
	FS7192	FS7215	FS7214	FS7216	FS7422	FS7527	FS7443	FS7530	FS7065
Unid. s.coat/periderm									
Unid. soft tissue		12	10	52			6		7
MODERN SEEDS:									
Amaranth									
cf. Bur									
Carpet weed									
Crowfoot grass					5				
cf. Cyperus sp.									
Euphorbia nutans					3				
Euphorb, cf. Ricinus									
cf. Goosefoot family			4						3
Grass family									
cf. Ground cherry									
Guava									
Legume family									
Mallow family									
Mexican poppy									
Panicoid grass					1				
Portulacaceae									
Purslane					1		3		6
Sunflower family					1				
Unid. spherical seed									
Unid. triangular seed							59		
Unid. seed, crenate									1
Unid. lobed fruit									
Unid. seed									
SEED TOTAL:	4	18	24	18	13	0	62	0	11
ARCHAEO. SEED TOTAL:	4	18	20	18	2	0	0	0	1

Appendix B--continued.

IDENTIFICATION:	Garden B continued Area 1 Lv.1 FS7191	Area 1 Lv.2 FS7072	Area 3A Lv.1 FS7334	Area 3B Lv.1 FS7335	----Area 4--- Lv.1 FS7331	Lv.4 FS7512	GARDEN C: Feat.10 Lv.1 FS6306	--Feature 11- Lv.2 FS6310	Lv.3 FS6312
CULTIVATED:									
cf. Guava									
Maize/Indian corn									2
cf. Manioc/cassava				(1)				16	144
Palm, seed coat									
Palm, fibrous tissue									
Pepper/pimiento									
Primrose						1			
cf. Soursop									
cf. Sapotaceae seed coat									
OTHER:									
Amaranthac./Chenopodiac.									
Goosefoot family					1	1			
cf. Inga/guaba									
Nightshade family									
Panicoid grass									
Purslane		4			5				
Trianthema						1			
cf. Grass family					3				
Legume, wild									
Mallow family									
cf. Myrtaceae									
cf. Palmae seed/bud									
Yellow stargrass						2			
Unid. seed-type 1									
Unid. seed-type 2									
Unid. seed-type 3									
Unid. seed-type 4									
Unid. seed-type 5									
Unid. seed/fruit frag.				1					3

Appendix B--continued.

IDENTIFICATION:	Garden B (continued) Area 1 Lv.1 FS7191	Area 1 Lv.2 FS7072	Area 3A Lv.1 FS7334	Area 3B Lv.1 FS7335	----Area 4--- Lv.1 FS7331	Lv.4 FS7512	GARDEN C: Feat.10 Lv.1 FS6306	--Feature 11- Lv.2 FS6310	Lv.3 FS6312
Unid. s.coat/periderm									
Unid. soft tissue	25	1	2	4	10	2	2	15	189
MODERN SEEDS:									
Amaranth									
cf. Bur									
Carpet weed									
Crowfoot grass			1	1		1			
cf. Cyperus sp.									
Euphorbia nutans									
Euphorb, cf. Ricinus									
cf. Goosefoot family									
Grass family									
cf. Ground cherry									
Guava									
Legume family									
Mallow family									
Mexican poppy						2			
Panicoid grass	1			26					
Portulacaceae									
Purslane				3					
Sunflower family									
Unid. spherical seed	1								
Unid. triangular seed						1			
Unid. seed, crenate									
Unid. lobed fruit									
Unid. seed									
SEED TOTAL:	2	4	1	31	9	9	0	0	5
ARCHAEO. SEED TOTAL:	0	4	0	1	9	5	0	0	5

Appendix B--continued.

IDENTIFICATION:	Garden C continued -------------Feat. 11 continued-----------						----Feature 15-------		
	Lv.4 FS6313	Lv.5 FS6316	Lv.6 FS6318	Lv.7 FS6320	Lv.8 FS6324	all lv FS6317	Lv.1 FS6746	Lv.2 FS6748	Lv.3 FS6751
CULTIVATED:									
cf. Guava									
Maize/Indian corn	3(3)	14(3)	3(4)			1			
cf. Manioc/cassava	49	157	164	92	30	68	(1)	(3)	(3)
Palm, seed coat		(1)							
Palm, fibrous tissue	++								
Pepper/pimiento									
Primrose									
cf. Soursop									
cf. Sapotaceae seed coat	1	1							
OTHER:									
Amaranthac./Chenopodiac.									
Goosefoot family									
cf. Inga/guaba		1							
Nightshade family									
Panicoid grass									
Purslane									
Trianthema									
cf. Grass family									
Legume, wild									
Mallow family									
cf. Myrtaceae									
cf. Palmae seed/bud									
Yellow stargrass									
Unid. seed-type 1									
Unid. seed-type 2									
Unid. seed-type 3									
Unid. seed-type 4									
Unid. seed-type 5									
Unid. seed/fruit frag.	3	3							

Appendix B--continued.

IDENTIFICATION:	Garden C (continued) Feat. 11 continued						Feature 15		
	Lv.4 FS6313	Lv.5 FS6316	Lv.6 FS6318	Lv.7 FS6320	Lv.8 FS6324	all lv FS6317	Lv.1 FS6746	Lv.2 FS6748	Lv.3 FS6751
Unid. s.coat/periderm									
Unid. soft tissue	++	66	41	35		24	1	1	
MODERN SEEDS:									
Amaranth									
cf. Bur									
Carpet weed									
Crowfoot grass									
cf. Cyperus sp.									
Euphorbia nutans									
Euphorb, cf. Ricinus									
cf. Goosefoot family									
Grass family									
cf. Ground cherry									
Guava									
Legume family									
Mallow family									
Mexican poppy									
Panicoid grass									
Portulacaceae									
Purslane									
Sunflower family									
Unid. spherical seed									
Unid. triangular seed									
Unid. seed, crenate									
Unid. lobed fruit									
Unid. seed									
SEED TOTAL:	10	23	7	0	0	1	0	0	0
ARCHAEO. SEED TOTAL:	10	23	7	0	0	1	0	0	0

Appendix B--continued.

IDENTIFICATION:	Garden C continued ----Feat. 15 continued----- Lv.1-3 FS6756	Lv.4 FS6752	Lv.5 FS6770	Ar.2 FS6750	Feat.15B Ar.6 FS6773	Zone 1 Lv.2 FS6302	Zone 2 Lv.01 FS6305	GARDEN E: --Feature 4--- Lv.5 FS3858	Lv.6 FS3862
CULTIVATED:									
cf. Guava									
Maize/Indian corn					1				
cf. Manioc/cassava	(5)	12		(9)	2				
Palm, seed coat						1			
Palm, fibrous tissue									
Pepper/pimiento									
Primrose							1		
cf. Soursop									
cf. Sapotaceae seed coat									
OTHER:									
Amaranthac./Chenopodiac.									
Goosefoot family									
cf. Inga/guaba									
Nightshade family									
Panicoid grass									
Purslane									
Trianthema						9			
cf. Grass family									
Legume, wild						2			
Mallow family									
cf. Myrtaceae									
cf. Palmae seed/bud									
Yellow stargrass									
Unid. seed-type 1									
Unid. seed-type 2									
Unid. seed-type 3									
Unid. seed-type 4									
Unid. seed-type 5									
Unid. seed/fruit frag.			1						

Appendix B--continued.

IDENTIFICATION:	Garden C (continued) ----Feat. 15 continued-----				Feat.15B	Zone 1	Zone 2	Garden E (cont.) ---Feature 4--	
	Lv.1-3 FS6756	Lv.4 FS6752	Lv.5 FS6770	Ar.2 FS6750	Ar.6 FS6773	Lv.2 FS6302	Lv.01 FS6305	Lv.5 FS3858	Lv.6 FS3862
Unid. s.coat/periderm									
Unid. soft tissue		10	23	3	7				
MODERN SEEDS:									
Amaranth									
cf. Bur									
Carpet weed									
Crowfoot grass									
cf. Cyperus sp.									
Euphorbia nutans									
Euphorb, cf. Ricinus									
cf. Goosefoot family						33	1		
Grass family									
cf. Ground cherry									
Guava							1		
Legume family									
Mallow family									
Mexican poppy									
Panicoid grass									
Portulacaceae									
Purslane							2		
Sunflower family									
Unid. spherical seed									
Unid. triangular seed									
Unid. seed, crenate									
Unid. lobed fruit									
Unid. seed									
SEED TOTAL:	0	0	1	0	1	45	5	0	0
ARCHAEO. SEED TOTAL:	0	0	1	0	1	12	1	0	0

Appendix B--continued.

IDENTIFICATION:	Garden E continued Feature 4 Lv.7 FS3864	 Lv.8 FS3866	 Lv.8 FS3881	 Lv.11 FS3885	 Lv.12 FS3886	 Feature 14 Lv.1 FS6730	 Lv.3 FS6898	 Lv.3 FS6903	 Lv.5 FS6991
CULTIVATED:									
cf. Guava									
Maize/Indian corn								1	
cf. Manioc/cassava		(2)				1		(1)	(3)
Palm, seed coat									
Palm, fibrous tissue									
Pepper/pimiento									
Primrose							14	35	33
cf. Soursop									
cf. Sapotaceae seed coat									
OTHER:									
Amaranthac./Chenopodiac.							1		
Goosefoot family									
cf. Inga/guaba								3	
Nightshade family								(1)	
Panicoid grass									
Purslane									
Trianthema				2			18		
cf. Grass family									
Legume, wild								2	
Mallow family							1	1	
cf. Myrtaceae									
cf. Palmae seed/bud									
Yellow stargrass									
Unid. seed-type 1									
Unid. seed-type 2									
Unid. seed-type 3									
Unid. seed-type 4									
Unid. seed-type 5			1						
Unid. seed/fruit frag.								3	1

Appendix B--continued.

IDENTIFICATION:	Garden E (continued) ----------Feature 4----------					----------Feature 14----------			
	Lv.7 FS3864	Lv.8 FS3866	Lv.8 FS3881	Lv.11 FS3885	Lv.12 FS3886	Lv.1 FS6730	Lv.3 FS6898	Lv.3 FS6903	Lv.5 FS6991
Unid. s.coat/periderm									
Unid. soft tissue							2	4	1
MODERN SEEDS:									
Amaranth							2		
cf. Bur							1		
Carpet weed							10		
Crowfoot grass									
cf. Cyperus sp.									
Euphorbia nutans							1		
Euphorb, cf. Ricinus									
cf. Goosefoot family			3	15			2		
Grass family									
cf. Ground cherry							1		
Guava									
Legume family									
Mallow family				1					
Mexican poppy							1	1	1
Panicoid grass				1			1		
Portulacaceae									
Purslane							19		
Sunflower family							1		
Unid. spherical seed									
Unid. triangular seed							1		
Unid. seed, crenate									3
Unid. lobed fruit									
Unid. seed									
SEED TOTAL:	0	0	4	19	0	0	74	47	38
ARCHAEO. SEED TOTAL:	0	0	1	2	0	0	34	46	34

Appendix B--continued.

IDENTIFICATION:	Garden E continued Fea.14A Lv.1 FS7020	Fea.14B Lv.1 FS7022	Fea.14C Lv.1 FS7023	Feat.16 Lv.3 FS6789	Fea.25 lv.1 FS7017	Fea.26 Lv.4 FS7123	Fea.47A Lv.1 FS7372	Feature 49 Lv.2 7465	Lv.3 7469
CULTIVATED:									
cf. Guava	1								
Maize/Indian corn	(1)				3(1)				
cf. Manioc/cassava	(4)				(3)	(3)		9	(2)
Palm, seed coat									
Palm, fibrous tissue									
Pepper/pimiento							5		
Primrose	149	10	3				1		
cf. Soursop									
cf. Sapotaceae seed coat									
OTHER:									
Amaranthac./Chenopodiac.	1						1		
Goosefoot family	1				1				
cf. Inga/guaba									
Nightshade family	1								
Panicoid grass									
Purslane									
Trianthema									
cf. Grass family									
Legume, wild	2								
Mallow family									
cf. Myrtaceae									
cf. Palmae seed/bud									
Yellow stargrass									
Unid. seed-type 1							1		
Unid. seed-type 2							1		
Unid. seed-type 3									
Unid. seed-type 4									1
Unid. seed-type 5					1				
Unid. seed/fruit frag.	2						2		

Appendix B--continued.

IDENTIFICATION:	Garden E (continued) Fea.14A Lv.1 FS7020	Fea.14B Lv.1 FS7022	Fea.14C Lv.1 FS7023	Feat.16 Lv.3 FS6789	Fea.25 lv.1 FS7017	Fea.26 Lv.4 FS7123	Fea.47A Lv.1 FS7372	Feature 49 Lv.2 7465	Feature 49 Lv.3 7469
Unid. s.coat/periderm									
Unid. soft tissue	6	3	1	3	7		15		11
MODERN SEEDS:									
Amaranth									
cf. Bur									
Carpet weed									
Crowfoot grass									
cf. Cyperus sp.									
Euphorbia nutans									
Euphorb, cf. Ricinus									1
cf. Goosefoot family									
Grass family									
cf. Ground cherry									
Guava									
Legume family									
Mallow family									
Mexican poppy									
Panicoid grass									
Portulacaceae									
Purslane	1								
Sunflower family									
Unid. spherical seed									
Unid. triangular seed									
Unid. seed, crenate	1								
Unid. lobed fruit									
Unid. seed									
SEED TOTAL:	160	10	3	0	6	0	11	0	2
ARCHAEO. SEED TOTAL:	158	10	3	0	6	0	11	0	1

Appendix B--continued.

IDENTIFICATION:	Garden E continued ----Feat. 49 continued----- Lv.5 FS7487	Lv.6 FS7497	Lv.9 FS7585	Lv.11 FS7589	Area 1 Lv.1 FS6340	Area 1 FS3745	Area 3 ash FS7040	Area 6 FS3746	Area 20 Lv.1 FS7035
CULTIVATED:									
cf. Guava									
Maize/Indian corn						2(2)	2(1)		1(2)
cf. Manioc/cassava	17	(7)	3	(2)				6	
Palm, seed coat									
Palm, fibrous tissue									
Pepper/pimiento									1
Primrose					1				
cf. Soursop									
cf. Sapotaceae seed coat									
OTHER:									
Amaranthac./Chenopodiac.									
Goosefoot family									1
cf. Inga/guaba						1			
Nightshade family									
Panicoid grass									
Purslane									
Trianthema									
cf. Grass family									
Legume, wild									
Mallow family									
cf. Myrtaceae									
cf. Palmae seed/bud									
Yellow stargrass									
Unid. seed-type 1									
Unid. seed-type 2									
Unid. seed-type 3									
Unid. seed-type 4									
Unid. seed-type 5									
Unid. seed/fruit frag.							2		1

Appendix B--continued.

IDENTIFICATION:	Garden E (continued) ----Feat. 49 continued----- Lv.5 FS7487	Lv.6 FS7497	Lv.9 FS7585	Lv.11 FS7589	Area 1 Lv.1 FS6340	Area 1 FS3745	Area 3 ash FS7040	Area 6 FS3746	Area 20 Lv.1 FS7035
Unid. s.coat/periderm									2
Unid. soft tissue			1			24	10		29
MODERN SEEDS:									
Amaranth									
cf. Bur									
Carpet weed									
Crowfoot grass									
cf. Cyperus sp.									
Euphorbia nutans									
Euphorb, cf. Ricinus									
cf. Goosefoot family									
Grass family									
cf. Ground cherry									
Guava									
Legume family									
Mallow family									
Mexican poppy									
Panicoid grass							1		
Portulacaceae									
Purslane									
Sunflower family									
Unid. spherical seed									
Unid. triangular seed									
Unid. seed, crenate									
Unid. lobed fruit									
Unid. seed									
SEED TOTAL:	0	0	0	0	1	4	6	0	6
ARCHAEO. SEED TOTAL:	0	0	0	0	1	4	5	0	6

Appendix B--continued.

IDENTIFICATION:	Garden E continued Zone 2 Lv.1 FS7037	----Zone 3---- Lv.5 FS7010	Lv.5 FS7374	PLANT TOTAL	PLANT UBIQUITY
CULTIVATED:					
cf. Guava				2	5.7
Maize/Indian corn				59	34.3
cf. Manioc/cassava		(2)		827++	37.1
Palm, seed coat				2	5.7
Palm, fibrous tissue				++	2.9
Pepper/pimiento				6	5.7
Primrose	1			251	28.6
cf. Soursop				1	2.9
cf. Sapotaceae seed coat				5	5.7
OTHER:					
Amaranthac./Chenopodiac.				5	14.3
Goosefoot family				6	14.3
cf. Inga/guaba				13	17.1
Nightshade family				2	5.7
Panicoid grass	1			21	11.4
Purslane				46	17.1
Trianthema	3			42	22.9
cf. Grass family				3	2.9
Legume, wild				6	14.3
Mallow family				2	2.9
cf. Myrtaceae				1	2.9
cf. Palmae seed/bud	1			4	5.7
Yellow stargrass				2	2.9
Unid. seed-type 1				1	2.9
Unid. seed-type 2				2	5.7
Unid. seed-type 3				5	2.9
Unid. seed-type 4				1	2.9
Unid. seed-type 5				4	8.8
Unid. seed/fruit frag.					

Appendix B--continued.

IDENTIFICATION:	Garden E (continued) Zone 2 Lv.1 FS7037	----Zone 3---- Lv.5 FS7010	Lv.5 FS7374	PLANT TOTAL	PLANT UBIQUITY
Unid. s.coat/periderm					
Unid. soft tissue	11	2			
MODERN SEEDS:					
Amaranth				2	2.9
cf. Bur				1	2.9
Carpet weed				14	8.8
Crowfoot grass				8	11.4
cf. Cyperus sp.				1	2.9
Euphorbia nutans				9	11.4
Euphorb, cf. Ricinus				1	2.9
cf. Goosefoot family	4			65	20.0
Grass family				1	2.9
cf. Ground cherry				1	2.9
Guava				1	2.9
Legume family				2	2.9
Mallow family				9	5.7
Mexican poppy	9			14	8.8
Panicoid grass	1			36	22.9
Portulacaceae				20	2.9
Purslane				41	25.7
Sunflower family				3	8.6
Unid. spherical seed				2	5.7
Unid. triangular seed				81	11.4
Unid. seed, crenate				5	8.6
Unid. lobed fruit				1	2.9
Unid. seed					
SEED TOTAL:	20	0	0		
ARCHAEO. SEED TOTAL:	6	0	0		

APPENDIX C

WOOD IDENTIFICATIONS FROM EN BAS SALINE

Appendix C. Wood identifications from En Bas Saline (relative frequency).
(Values on parentheses are provisional identifications.)

IDENTIFICATION:	GARDEN B: Feat.24 Bur.01 FS6989	Feature 31 Lv.1 FS7190	Feature 31 Lv.2 FS7198	Feature 31 Lv.3 FS7197	Feature 31 Lv.3 FS7213	Feature 31 Lv.4 FS7211	Feature 31 Lv.4 FS7332	Fea.31A Lv.1 FS7199	Feat.33 Lv.3 FS7215
MANGROVE ASSOCIATION:									
Black mangrove	.50	1.00	.74	.70	.83	1.00	1.00	.76	.66
Buttonwood	.50		.13	.10	.10			.10	
cf. Buttonwood (satinwd)									
Red mangrove			.06	.20	.06			.10	
Red mangrove family									
POSSIBLE HOMEGARDEN:									
cf. Genip									
cf. Inga/guaba			.03						
cf. guava/stopper									
Palm			.03						
Sapotac., bullet-wood									
Sapotac., bustic/caimito									
OTHER:									
Boxwood									
Jagua/W.I. boxwood									
cf. Laurel family									
Monkey pistol									
Pine, Haitian								.03	
Poison wood/spicewood									
cf. Snake-bark									
cf. Stopper									
Sweetwood/satinwood									
cf. West Indian elm									
EBS-10 fig/genip									
EBS-15 black torch									
Unidentified hardwood									.33
TOTAL WOOD TYPES:	2	1	5	3	3	1	1	4	2
TOTAL NUMBER IDENTIFIED:	2	22	31	10	30	3	5	30	3

Appendix C--continued.

	Garden B continued Feat.33 Lv.4 FS7214	Post-mold-3 FS7443	-------Area 1------ lv.1 FS7065	Lv.1 FS7191	Lv.2 FS7072	Area 3A Lv.1 FS7334	Area 3B Lv.1 FS7335	Area 4 Lv.4 FS7512	GARD. C Feat.15 Lv.4 FS6752
MANGROVE ASSOCIATION:									
Black mangrove	.60		.92	.60	1.00	.55	.60	.87	.55
Buttonwood	.25			.27				.12	
cf. Buttonwood (satinwd)									
Red mangrove	.05	1.00	.04	.10					.25
Red mangrove family									
POSSIBLE HOMEGARDEN:									
cf. Genip						.22			
cf. Inga/guaba									
cf. guava/stopper									
Palm	.10								
Sapotac., bullet-wood									
Sapotac., bustic/caimito				.03					.15
OTHER:									
Boxwood									
Jagua/W.I. boxwood									
cf. Laurel family									
Monkey pistol									
Pine, Haitian									
Poison wood/spicewood									
cf. Snake-bark									
cf. Stopper									.02
Sweetwood/satinwood									
cf. West Indian elm									
EBS-10 fig/genip									
EBS-15 black torch						.22			
Unidentified hardwood			.04				.40		.02
TOTAL WOOD TYPES:	4	1	2	4	1	3	2	2	5
TOTAL NUMBER IDENTIFIED:	20	1	25	30	1	9	5	8	40

Appendix C--continued.

	GARDEN E:								
	Feature 4							Feat.6	Feat.6
	Lv.3 FS3851	lv.5 FS3858	Lv.6 FS3862	Lv.7 FS3864	Lv.8 FS3881	Lv.10 FS3883	Lv.12 FS3886	Lv.3 FS3840	Lv.4 FS3860
MANGROVE ASSOCIATION:									
Black mangrove	.08	.40	.24	.34	.20	.56	.89		.37
Buttonwood	.18	.11	.18	.10	.09	.09			.11
cf. Buttonwood (satinwd)		.13	.43	.12	.42	.22			.22
Red mangrove		.11	.03	.02		.03	.11		.22
Red mangrove family			.02						
POSSIBLE HOMEGARDENS:									
cf. Genip									
cf. Inga/guaba						.03			.04
cf. guava/stopper									
Palm	.71	.01							
Sapotac., bullet-wood			.01	(.01)		(.03)			
Sapotac., bustic/caimito									
OTHER:									
Boxwood		(.02)		(.06)	(.07)				
Jagau/W.I. boxwood		.01							
cf. Laurel family				.10					.04
Monkey pistol				.03				.66	
Pine, Haitian									
Poison wood/spicewood									
cf. Snake-bark		.08		.01	.04				
cf. Stopper									
Sweetwood/satinwood									
cf. West Indian elm									
EBS-10 fig/genip		.04		.04					
EBS-15 black torch									
Unidentified hardwood	.03	.07	.08	.16	.18	.03		.33	
TOTAL WOOD TYPES:	3	9	6	10	5	6	2	2	6
TOTAL NUMBER IDENTIFIED:	38	89	95	88	45	32	9	3	27

Appendix C--continued.

	GARDEN E contiued								
	--------------Feature 6-----------					Feat.7	Feat.7	Feat.8	Feat.8
	lv.6	Lv.7	Lv.8	Lv.10	Lv.10	Lv.1	Lv.2	Lv.2	Lv.3
	FS3867	FS3868	FS3882	FS3890	FS3910	FS3856	FS3857	FS3892	FS3897
MANGROVE ASSOCIATION:									
Black mangrove	.25	1.00		.63		.60	1.00	.50	
Buttonwood	.08			.10	1.00	.20			.17
cf. Buttonwood (satinwd)	.25					.07			.66
Red mangrove				.14					
Red mangrove family									
POSSIBLE HOMEGARDEN:									
cf. Genip									
cf. Inga/guaba			1.00						
cf. guava/stopper									
Palm									
Sapotac., bullet-wood									
Sapotac., bustic/caimito									
OTHER:									
Boxwood									
Jagau/W.I. boxwood				.03		.07			
cf. Laurel family									
Monkey pistol									
Pine, Haitian									
Poison wood/spicewood									
cf. Snake-bark									
cf. Stopper									
Sweetwood/satinwood									
cf. West Indian elm									
EBS-10 fig/genip									
EBS-15 black torch									
Unidentified hardwood	.42			.10		.07		.50	.17
TOTAL WOOD TYPES:	3	1	1	4	1	4	1	1	2
TOTAL NUMBER IDENTIFIED:	12	1	1	38	1	15	4	2	6

Appendix C--continued.

	Garden E continued								
	Fea.8	Fea.8N	Fea.8	---Fea.14---		Fea.14A	--Fea.14B---		Fea.14C
	Lv.5	Lv.6	Lv.8	Lv.3	Lv.5	Lv.1	Lv.1	Lv.2	Lv.1
	FS3900	FS3913	FS3898	FS6898	FS6991	FS7020	FS7022	FS7044	FS7023
MANGROVE ASSOCIATION:									
Black mangrove	.33	.17		.25	1.00	.94	1.00	1.00	
Buttonwood		.66		(.25)					.50
cf. Buttonwood (satinwd)									
Red mangrove	.33			.25		.06			
Red mangrove family									
POSSIBLE HOMEGARDEN:									
cf. Genip				.25					
cf. Inga/guaba									
cf. guava/stopper									
Palm									.50
Sapotac., bullet-wood									
Sapotac., bustic/caimito									
OTHER:									
Boxwood									
Jagau/W.I. boxwood									
cf. Laurel family									
Monkey pistol			.66						
Pine, Haitian			.33						
Poison wood/spicewood									
cf. Snake-bark									
cf. Stopper									
Sweetwood/satinwood									
cf. West Indian elm									
EBS-10 fig/genip									
EBS-15 black torch									
Unidentified hardwood	.33	.17							
TOTAL WOOD TYPES:	2	2	2	4	1	2	1	1	2
TOTAL NUMBER IDENTIFIED:	3	6	3	4	2	16	5	1	2

Appendix C--continued.

	Garden E continued								
	Fea.14C	---Feat.25---		Fea.47A	----------Feature 49------------				
	Lv.2	lv.1	Lv.2	Lv.1	Lv.3	Lv.6	PM-10	Lv.9	Lv.11
	FS7054	FS7017	FS7047	FS7372	FS7469	FS7497	FS7588	FS7585	FS7589
MANGROVE ASSOCIATION:									
Black mangrove	.50	.58	.83	.77	.60	.30	1.00	.36	.74
Buttonwood		.28	.17	.07	.23	.27		.52	.05
cf. Buttonwood (satinwd)									
Red mangrove	.50			.13	.10	.27		.12	.21
Red mangrove family									
POSSIBLE HOMEGARDEN:									
cf. Genip									
cf. Inga/guaba		.05				.03			
cf. guava/stopper		.02				.07			
Palm					.03				
Sapotac., bullet-wood									
Sapotac., bustic/caimito		.02				.03			
OTHER:									
Boxwood									
Jagau/W.I. boxwood									
cf. Laurel family									
Monkey pistol									
Pine, Haitian				.03					
Poison wood/spicewood									
cf. Snake-bark						.03			
cf. Stopper									
Sweetwood/satinwood		.05							
cf. West Indian elm									
EBS-10 fig/genip									
EBS-15 black torch									
Unidentified hardwood					.03				
TOTAL WOOD TYPES:	2	6	2	4	4	7	1	3	3
TOTAL NUMBER IDENTIFIED:	2	40	6	30	30	30	30	25	19

Appendix C--continued.

	Garden E continued Fea.49 Lv.13 FS7592	Postm. #15 FS3911	Area 3 ash FS7040	Area 4 all FS3865	Area 6 Lv.1 FS3888	Area 6 Lv.2 FS6863	Area 6 Lv.5 FS6880	Area 6 Lv.6 FS6882	Area 6 Lv.7 FS6884
MANGROVE ASSOCIATION:									
Black mangrove	1.00		.62	.61	.62	.17	.53	.46	.52
Buttonwood			.09	.05	.12	.17	.18	.31	.04
cf. Buttonwood (satinwd)				.05			.02	.23	.16
Red mangrove			.05	(.05)		.12	.04		
Red mangrove family									
POSSIBLE HOMEGARDEN:									
cf. Genip									
cf. Inga/guaba									
cf. guava/stopper									
Palm						.17	.04		.03
Sapotac., bullet-wood									(.01)
Sapotac., bustic/caimito									
OTHER:									
Boxwood				.17					
Jagua/W.I. boxwood									
cf. Laurel family									
Monkey pistol						.06			
Pine, Haitian							.08		.01
Poison wood/spicewood		.80(.93)							
cf. Snake-bark			.09				.06		
cf. Stopper						.06			.18
Sweetwood/satinwood									
cf. West Indian elm			.14						
EBS-10 fig/genip									.01
EBS-15 black torch									
Unidentified hardwood		.07		.05	.25	.24	.04		.03
TOTAL WOOD TYPES:	1	1	5	5	2	7	7	3	8
TOTAL NUMBER IDENTIFIED:	8	15	21	18	8	17	49	13	75

Appendix C--continued.

	Garden E continued Area 20 Lv.1 FS7035	Zone 1 Lv.3 FS3797	Zone 2 Lv.1 FS7037	----Zone 3----- Lv.5 FS7010	Lv.5 FS7374
MANGROVE ASSOCIATION:					
Black mangrove				.57	.50
Buttonwood				.14	.16
cf. Buttonwood (satinwd)					
Red mangrove				.09	.16
Red mangrove family					
POSSIBLE HOMEGARDEN:					
cf. Genip					
cf. Inga/guaba					.16
cf. guava/stopper					
Palm	1.00				
Sapotac., bullet-wood					
Sapotac., bustic/caimito		1.00			
OTHER:					
Boxwood				.05	
Jagua/W.I. boxwood					
cf. Laurel family					
Monkey pistol				.05	
Pine, Haitian					
Poison wood/spicewood					
cf. Snake-bark					
cf. Stopper					
Sweetwood/satinwood					
cf. West Indian elm					
EBS-10 fig/genip					
EBS-15 black torch					
Unidentified hardwood			1.00	.09	
TOTAL WOOD TYPES:	1	1	1	5	4
TOTAL NUMBER IDENTIFIED:	6	2	1	21	6

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BIOGRAPHICAL SKETCH

Lee Ann Martin Newsom was born in Port Layote, Morocco. She has been interested in archaeology and prehistoric culture since childhood. She received an interdisciplinary B.A. in anthropology and botany from the University of Florida in 1984. In the succeeding years she gained varied field and laboratory experience with a number of archeological projects in Florida, the eastern United States, and the Caribbean.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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This dissertation was submitted to the Graduate Faculty of the Department of Anthropology in the College of Liberal Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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